Bicycle, Automotive and Pedestrian Safety Evaluation

May 2011

in association with

Toole Design Group
BOSTON MA · WASHINGTON DC · SEATTLE WA

Sabra, Wang & Associates, Inc.
Engineers · Planners · Analysts

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1.0 EXECUTIVE SUMMARY

1.1 Study Purpose

The City of Annapolis is a nationally renowned destination, uniquely situated on the Chesapeake Bay at the mouth of the Severn River, and steeped in cultural and political history. As capital of Maryland, the City is bustling with commerce, education and the business of government. The existing transportation network is a limited resource that must be efficiently managed to safely serve the needs of a diverse body of users including bicycles, automobiles, pedestrians and transit vehicles. The purpose of this study is to 1) document existing safety and operational conditions for bicyclists, motorists and pedestrians by evaluating conflict points and dynamic movements of each mode focusing on the Downtown/ City Dock area, 2) develop short-term recommendations for improving the safety, operations and connectivity of modal facilities, and 3) inform the City Dock planning effort, which began in 2010 and is led by the City working with the City Dock Advisory Committee (CDAC). The results of this study will be used to plan long-term capital infrastructure improvements, special event traffic management, and public space improvements. The increased use of non-motorized modes of travel in the downtown area will reduce traffic congestion, enhance mobility, improve the environment, promote economic opportunity and enhance safety.

In the past five years, there has been a renewed interest in making the City Dock area more accessible and friendly to non-automobile modes of travel, and reduce the need for visitors to continue to drive their cars into the downtown. The current patterns of automobile circulation and traffic volumes, along with limited street parking and high volumes of pedestrians has often led to recurring congestion and limits mobility in and out of the City during both weekday and weekend hours. The perceived lack of pedestrian safety, lack of parking, and visitors idling cars in traffic for long periods of time has frustrated local residents and tourists alike. Traffic congestion and concern for pedestrian and bicycle safety are the key drivers to develop improved circulation patterns, pedestrian and bicycle facilities and prioritization, wayfinding systems, and parking management.

Key challenges of this study included 1) finding the right modal balance and priorities that enhance access and safety for pedestrians and bicycles while maintaining adequate vehicle operations including trucks, 2) developing low-cost short-term localized improvements that will measurably improve traffic operations and pedestrian and bicycle safety without requiring major physical modifications (e.g. roadway widening), large-scale traffic pattern changes, and extensive senior agency oversight, and 3) maintaining convenient and accessible short-term and long-term parking to support local businesses.

1.2 Study Goals

The City of Annapolis Bicycle, Automotive and Pedestrian safety study is a comprehensive assessment of the existing and future mobility needs for the downtown City Dock area. The goal of the transportation study is to develop a set of recommendations for existing and future roadway circulation, pedestrian and bicycle facilities and prioritizations, transit services and parking management to support a safe and environmentally friendly transit, pedestrian and bicycle-oriented downtown. Specifically, the study will assist the City in efforts to:

- Improve safety and enhance transportation network efficiency, focusing on the City Dock area
- Identify key conflict points using a unique analysis methodology
- Document the non-motorized transportation network gaps and barriers
- Provide short and long-term cost-sensitive strategies that:
    - Enhance safety and mobility for all travelers while managing congestion
    - Improve inter-modal connections and parking efficiency
    - Create open spaces and improve access to the waterfront
    - Minimize impact on residential streets
- Effectively guide visitors, tourists and workers to key destinations within the City
- Improve travel choices and increase biking and walking trips

1.3 Study Scope

The scope of this study included the following elements:

- Inventory and document the existing transportation network, including roads, sidewalks, on-and off-street parking supply and regulations, and transit services;
- Collect existing usage data including automobile, bus, truck, pedestrian and bicycle traffic volumes; transit ridership, modal shares, and parking utilizations
- Review crash data and pedestrian, bicycle and motorized vehicle risky behaviors, and evaluate key conflict points and origin-destination patterns
- Identify existing gaps in the pedestrian, bicycle, and transit networks

- Develop preliminary recommendations for preferred roadway, sidewalk, bicycle, parking, and traffic control improvements.

1.4 Findings and Study Recommendations

The results of the study revealed the following key modal issues:

The ***pedestrian environment*** is defined by high pedestrian volumes, complicated crossing of wide vehicle lanes and intersections, frequently desired mid-block crossings, unfamiliar tourists and distracted pedestrians, conflicts with high volumes of turning vehicles at key locations, and major pedestrian traffic generators such as Market House, City Dock, Main Street, the U.S. Naval Academy and St. Mary's School

The ***bicycle environment*** is defined by competition for limited space with high motor vehicle volumes, conflicts with turning vehicles and pedestrians, conflicts with parked cars, limited connections to regional and city-wide designated bicycle routes and trails, limited bicycle parking and limited wayfinding signing.

The ***automobile environment*** is defined by competition between automobiles and other modes for limited roadway space, unfamiliar drivers, friction of parking maneuvers and searching for available parking, tour and transit bus operations, conflicts with bicycles and high pedestrian volumes, accommodation of through/ cross-town traffic in the downtown/ City Dock area, and ad-hoc truck loading and unloading

The ***transit environment*** is defined by limited service frequencies on some routes, limited connections between satellite garages and the City Dock, limited connections between regional and local buses, lack of real-time transit info, and limited bus stop amenities such as shelters and benches.

The ***parking environment*** is defined by ample supply, over-utilization of the downtown surface lots and garages, limited wayfinding signage, and limited real-time parking information.

In summary, missing connections and gaps were noted in the pedestrian, bicycle and transit networks such as sidewalks, bicycle lanes and parking, and bus stops, along with lack of priority in circulation patterns and traffic control treatments for non-automotive modes.

Development of ***improvement alternatives*** focused on creating complete streets with more balance in roadway space and intersections to prioritize vulnerable users, reducing redundant traffic patterns and circulation, and enhancing parking

management, strengthening intermodal connections and providing better signing and public information about parking and travel options.

Key recommendations include:

1. Memorial Circle Option 1: Reconfigure geometry of existing circle to improve vehicle channelization, reduce pedestrian crossing distance, and reduce roadway footprint.

2. Memorial Circle Option 2: Replace the existing circle with a traditional 'T' intersection to reduce roadway footprint, prioritize pedestrian crossings and implement a coordinated traffic signal to regulate traffic flow.

3. Randall Street Road Diet/ Signalization: Reduce the number of moving travel lanes along Randall Street, reduce pedestrian crossing distance, and provide a new traffic signal at the Dock Street intersection.

4. Market Space Road Diet: Reduce the roadway width, convert to parallel parking and reverse traffic flow (eastbound) away from Main Street to enhance pedestrian space and comfort.

5. City Dock Lot Improvements: Construct bumpouts, wider sidewalks, and medians within lot to improve pedestrian circulation.

6. Main Street Modification Option 1: Convert Main Street to two-way between Conduit Street and Green Street to provide alternative access to City Dock and reduce redundant volumes on Green and Duke of Gloucester Streets.

7. Main Street Modification Option 2: Install two-way Cycle Track along Main Street from City Dock to Church Circle to provide direct bicycle connections in and out of the downtown area.

8. Compromise Street at St. Mary's Street: construct a new median island for pedestrian refuge.

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2.0 INTRODUCTION

2.1 Study Background and Objective

As an historic seaport, tourist destination and seat of government, the City increasingly attracts visitors to its downtown City Dock during all seasons. While automobile travel is the primary mode of access, visitors, residents and workers also access the City Dock area by walking, biking, public transit or boat.

The existing transportation network is a limited resource that must be efficiently managed to safely serve the needs of a diverse body of users including bicycles, automobiles, pedestrians and transit vehicles. The purpose of this study is to 1) document existing safety and operational conditions for bicyclists, motorists and pedestrians by evaluating conflict points and dynamic movements of each mode focusing on the Downtown/ City Dock area, and 2) to develop short-term recommendations for improving the safety, operations and connectivity of modal facilities. The results of this study will be used to plan long-term capital infrastructure improvements, special event traffic management, and public space improvements. The increased use of non-motorized modes of travel in the downtown area will reduce traffic congestion, enhance mobility, improve the environment, promote economic opportunity and enhance safety.

In the past five years, there has been a renewed interest in making the City Dock area more accessible and friendly to non-automobile modes of travel, and reduce the need for visitors to continue to drive their cars into the downtown. The current patterns of automobile circulation and traffic volumes, along with limited street parking and high volume of pedestrians has often led to recurring congestion and limits mobility in and out of the City during both weekday and weekend hours. The perceived lack of pedestrian safety, lack of parking, and visitors idling cars in traffic for long periods of time has frustrated local residents and tourists alike. Additionally, residential parking is compromised especially during the high tourist summer season. Traffic congestion and concern for pedestrian and bicycle safety are the key drivers to develop improved circulation patterns, pedestrian and bicycle facilities and prioritization, wayfinding systems, and parking management.

Key challenges of this study included 1) finding the right modal balance and priorities that enhance access and safety for pedestrians and bicycles while maintaining adequate vehicle operations including trucks, 2) developing low-cost short-term localized improvements that will measurably improve traffic operations and pedestrian and bicycle safety without requiring major physical modifications (e.g. roadway widening), large-scale traffic pattern changes, and extensive senior agency oversight, and 3) maintaining convenient and accessible short-term and long-term parking to support local businesses.

Traffic volumes in the downtown area can fluctuate and are sensitive to the school-year calendar, legislative sessions, weather, holidays, special events such as Naval Academy games and the Boat Show, and religious institutions. In summary, the current roadway network configuration, traffic controls and parking facilities do not effectively accommodate the volume of automobiles driving into the City. There is a need to study measures of creating more travel options through revising traffic patterns, improving traffic controls, and enhancing safety for vulnerable pedestrians and bicyclists.

2.2 Study Area Location and Limits

The study area (centered around the downtown Annapolis City Dock) was chosen to best inform the City Dock planning effort. It consists of the directional roadways roughly bounded by King George Street to the east, Duke of Gloucester Street to the west, Spa Creek Bridge to the south and College Creek to the north. Major roads include:

- Compromise Street – between Eastport and Memorial Circle
- Main Street – Randall Street and Church Circle
- Randall Street – between Compromise Street and King George Street
- Duke of Gloucester Street – between Church Circle and Compromise Street
- College Avenue – between King George Street and Church Circle
- West Street – between Calvert Street and Church Circle
- King George Street – between Spa Creek and Randall Street

An area map of the study area roadway network, study intersections, and current intersection traffic controls is shown below.

Existing Conditions – Study Area Roadway Network – Annapolis City Dock

2.3 Review of Previous Studies

Previous studies conducted by the City, the Urban Land Institute, and other County and State agencies were reviewed as background materials for applicability and impact to this study as listed below:

- The Annapolis Bicycle Transportation Committee Final Report (2008)
- The City of Annapolis Transit Development Plan (2010)
- The Urban Land Institute Technical Assistance Panel City Dock Technical Report (2010)
- Main Street Route Reversal Study, Gorove/ Slade Associates, Inc. (1994)
- Annapolis Comprehensive Plan (2009) including year 2030 Level of Service
- Current parking, bicycle and transit information on City's website

2.4 Data Collection

Traffic data for this study included 7-day volume, speed and classification counts along Main Street, Duke of Gloucester Street, Compromise Street, Green Street, Randall Street, Prince George and King George Street in July (summer) and late August/ September (fall) of 2010.

In addition, supplemental intersection peak hour (AM, PM and Saturday) turning movement counts documenting automobiles, trucks, buses, pedestrian and bicycle volumes. These counts were performed at 25 intersections, including the six legs of Church Circle. These counts were performed in late October and early November of 2010.

A comprehensive field inventory was performed to obtain intersection approach photographs at study intersections and to identify key roadway characteristics (e.g., lane use, turn restrictions, parking restrictions, lane widths, storage bay lengths, traffic control, sight distance, lighting, posted speed limits and pavement quality). In addition, an inventory of pedestrian, bicycle, and transit facilities was conducted (e.g., sidewalk width and condition, curb ramps, pedestrian signals, crosswalks, bike lanes/trails, bus and stops and shelters).

Detailed traffic count data reports are in **Appendix A**, and existing conditions field inventory worksheets are in **Appendix B**.

3.0 EXISTING CONDITIONS

3.1 Study Intersections

The study area roadway network includes eleven signalized and fourteen unsignalized intersections. The study intersections and their respective traffic control include:

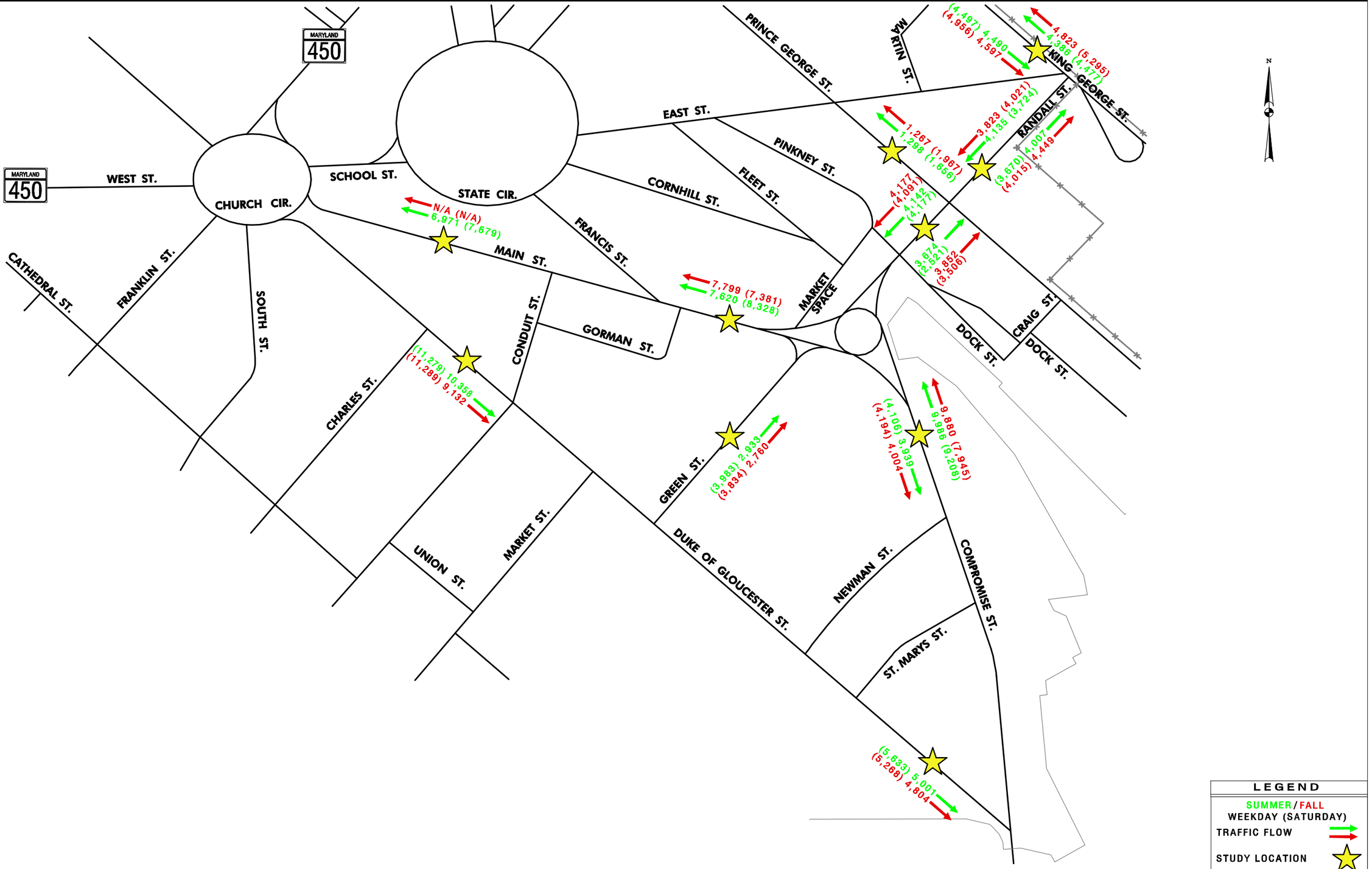
- Calvert Street at Northwest Street/ Rowe Blvd (signal)
- Calvert Street at Bladen Street (signal)
- College Avenue at Prince George Street (stop sign)
- College Avenue at King George Street (signal)
- West Street at Calvert Street/ Cathedral Street (signal)
- Church Circle at Northwest Street (signal)
- Church Circle at West Street (signal)
- Church Circle at South Street (yield sign)
- Church Circle at Duke of Gloucester Street (signal)
- Church Circle at Main Street (signal)
- Church Circle at College Avenue (yield sign)
- Maryland Avenue at State Circle (yield sign)

- East Street at Prince George Street (stop sign)
- East Street at King George Street/ Randall Street (signal)
- Main Street at Conduit Street (signal)
- Main Street at Green Street/ Market Space (stop sign)
- Main Street at Compromise Street/ Randall Street (yield signs)
- Randall Street at Dock Street (stop sign)
- Randall Street at Prince George Street (signal)
- Conduit Street at Cathedral Street (stop sign)
- Duke of Gloucester Street at Conduit Street (signal)
- Duke of Gloucester Street at Green Street (stop sign)
- Duke of Gloucester Street at Newman Street (stop sign)
- Newman Street at Compromise Street (stop sign)
- Duke of Gloucester Street at Compromise Street (stop sign)

3.2 Traffic Volumes

Commuter activity within the study area roadway network occurs in the morning from 7:00 to 8:00 AM and in the evening from 5:00 to 6:00 PM. Saturday peak hours run from 11 AM to 2 PM. Average Daily Traffic Volumes range from 1,500 to 12,000 vehicles per day. Approximately 1 to 3% of all traffic is heavy vehicles. High pedestrian volumes were noted at Church Circle and West, Duke of Gloucester and Main Streets, Main Street at Green Street and Compromise Street, and Randall Street at Dock Street.

Existing traffic counts including Average Daily Traffic, percent heavy vehicles, automobile, bus and truck turning movements, and pedestrian and bicycle turning movements are presented in **Figures 1 to 6**, respectively. **Appendix A** contains the raw traffic count data.



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City of Annapolis, Maryland

Average Daily Traffic Volumes:

Summer vs. Fall

Figure 1

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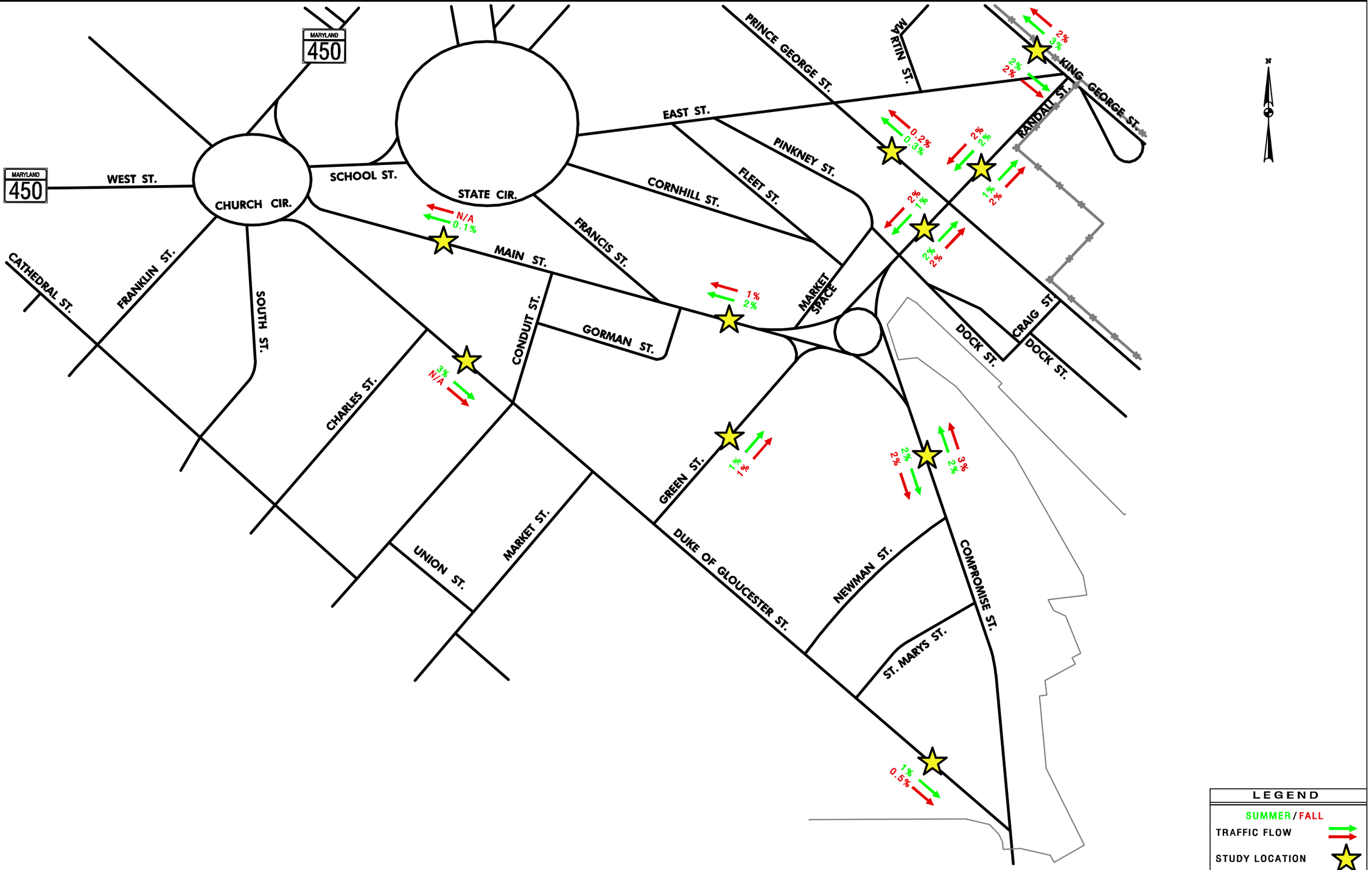

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Truck Percentages: Summer Vs. Fall

Figure 2

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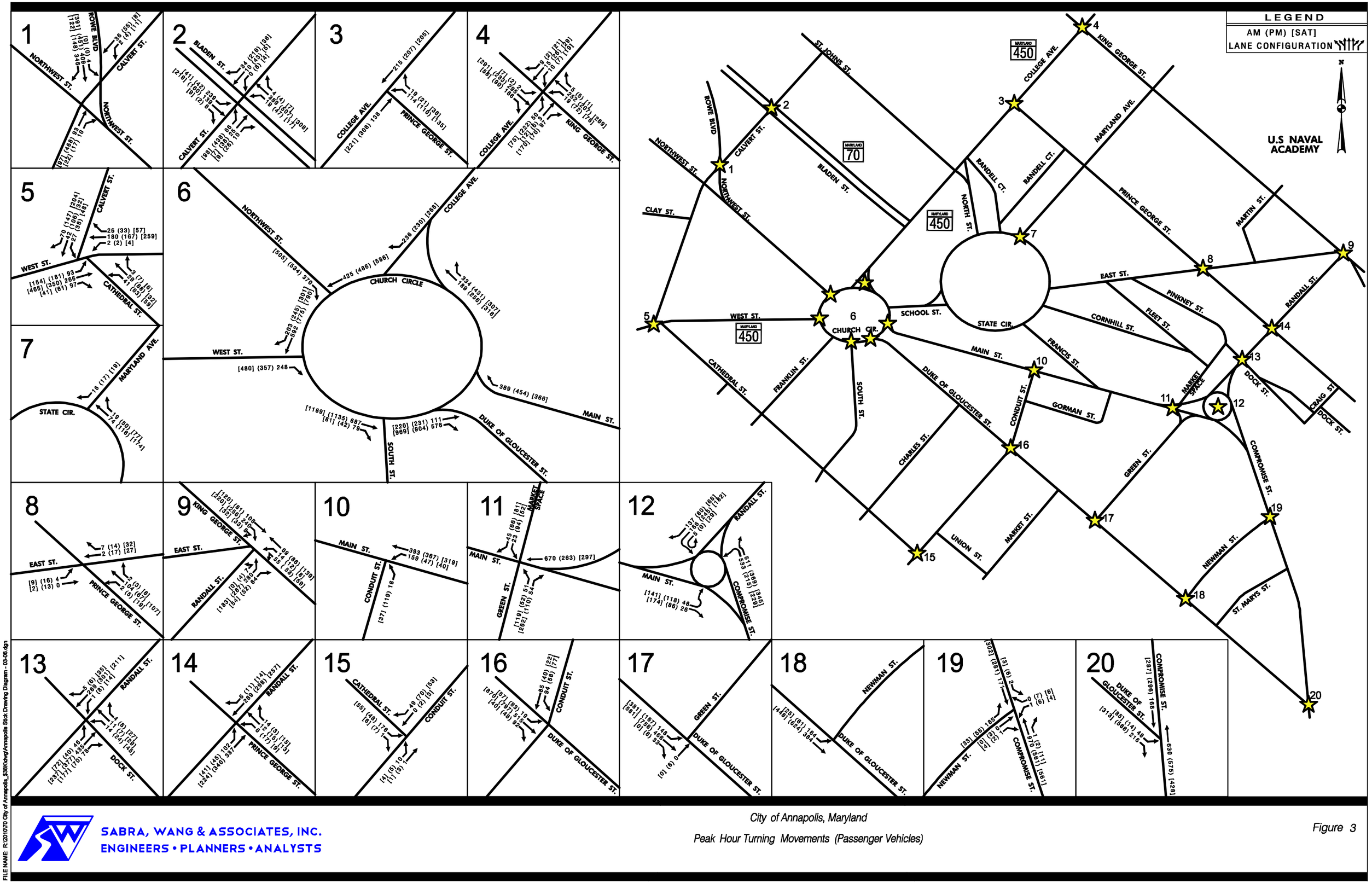

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Peak Hour Turning Movements (Passenger Vehicles)

Figure 3

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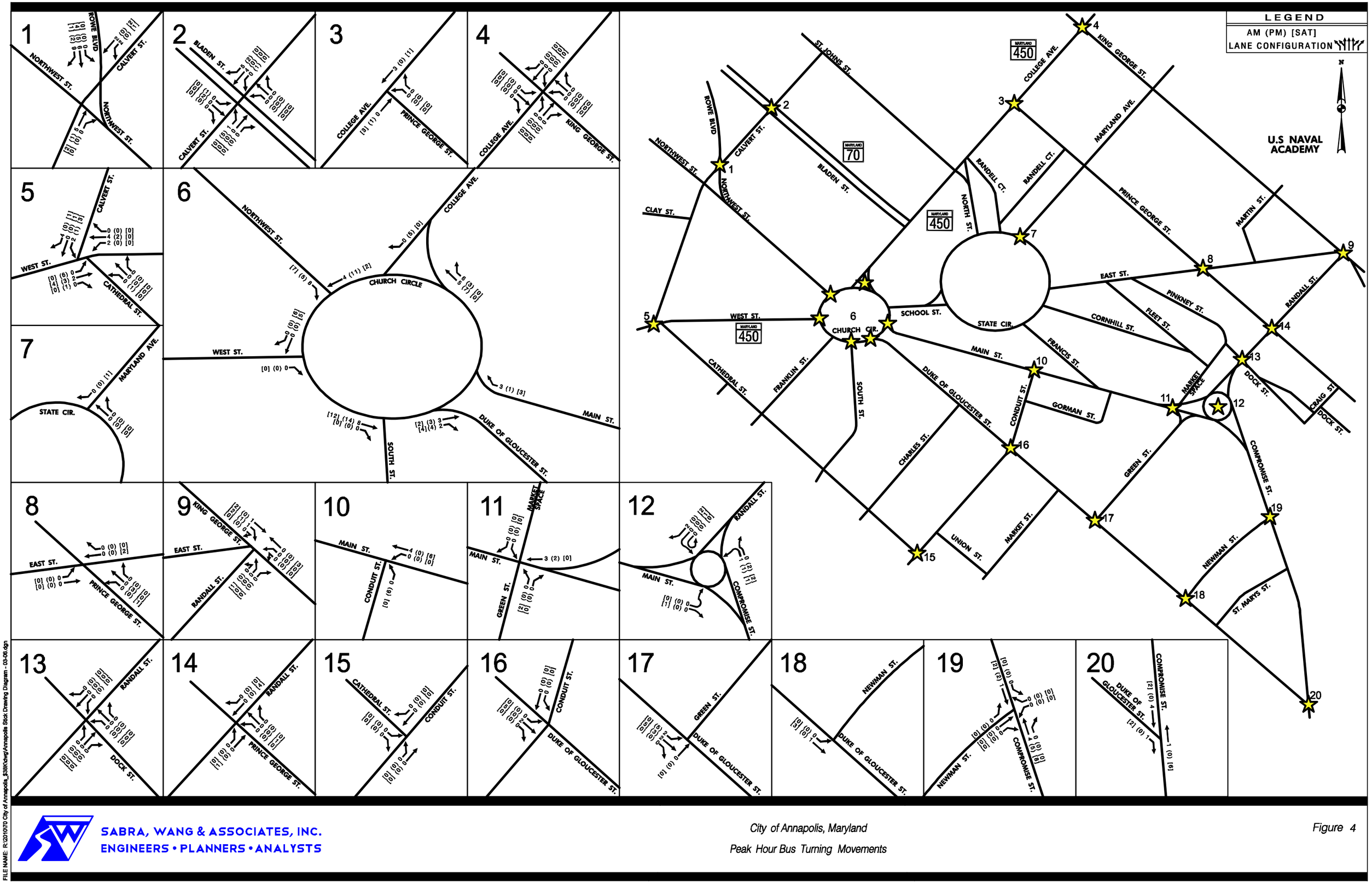

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Peak Hour Bus Turning Movements

Figure 4

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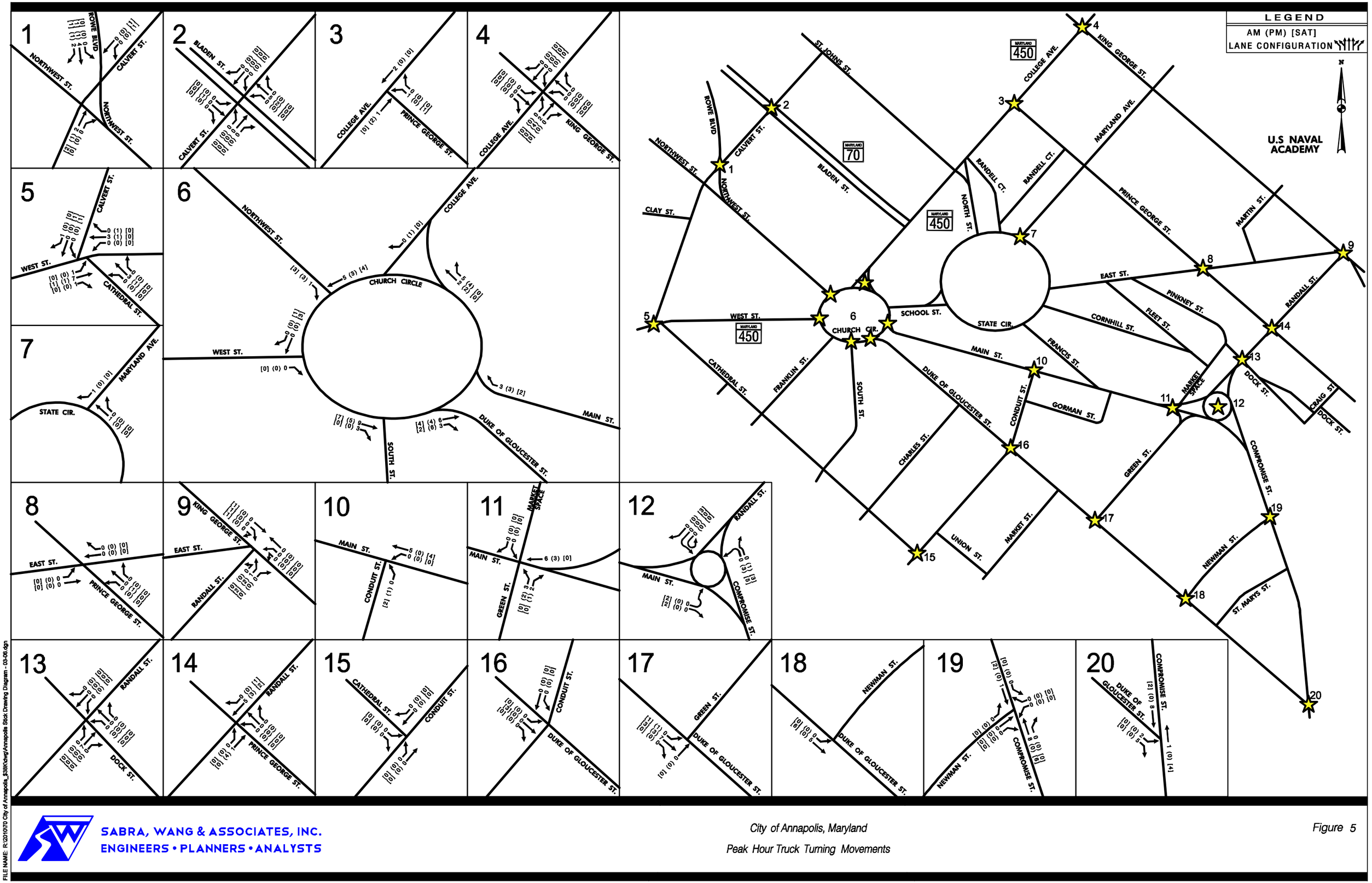

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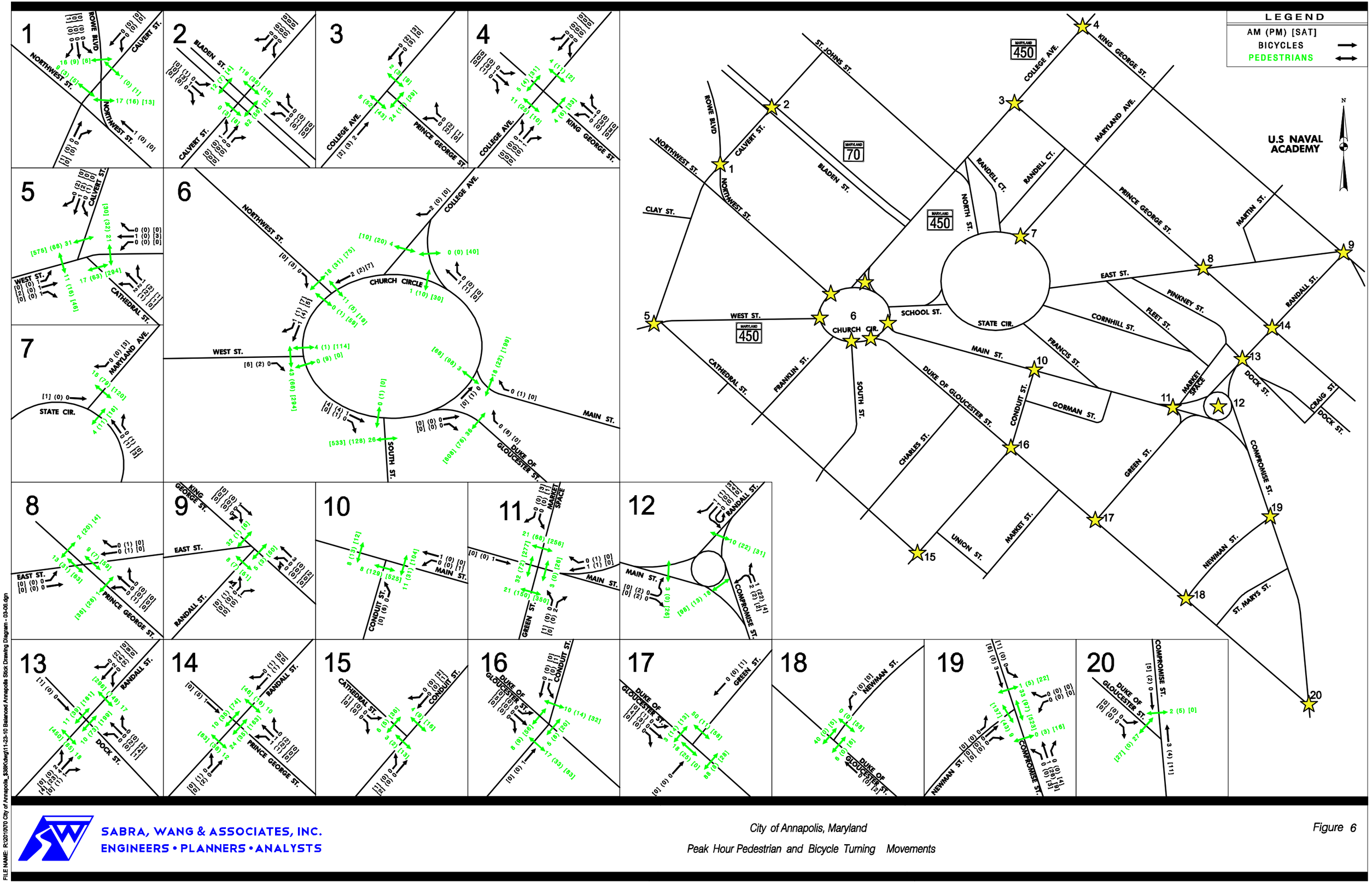
Peak Hour Truck Turning Movements

Figure 5



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Peak Hour Pedestrian and Bicycle Turning Movements

Figure 6

3.3 Traffic Signal Operations

The eleven traffic signals within the study area are operated and maintained by the City's Department of Public Works. Notable characteristics of the study area traffic signals are described below, and existing traffic signal timing charts are included in **Appendix C**.

- Signal operations varied from pre-timed to actuated and coordinated to uncoordinated.
- Along Church Circle signals run a 90-second cycle during all peak periods.
- Signals along Duke of Gloucester Street, Conduit Street, Randall Street, Main Street and King George Street run 60-second cycle lengths.
- Pedestrian push-buttons are provided at Conduit Street and Duke of Gloucester Street, Conduit Street and Main Street, Calvert Street at Rowe Boulevard, Calvert Street and West Street, and Calvert Street at Bladen Street.
- Vehicle detection is also provided at the signals along Conduit, College Avenue at King George Street, and the three signals along Calvert Street.
- Yellow and All-Red clearance intervals typically range from 3.5 to 4 seconds and 0.5 to 2.0 seconds, respectively.
- Traffic signal mounting includes span mount, pole mount and mast arm mount.

3.4 Pedestrian and Bicycle Facilities

Existing Conditions for Pedestrians

The land uses and scale around the Annapolis City Dock and Main Street corridor encourage pedestrian travel. There are numerous destinations within close proximity to each other, and the relatively low motor vehicle traffic speeds creates a comfortable walking experience. As a result, pedestrians can be seen walking throughout the area.
In general, walking conditions parallel to roadways are fairly good. Most walking surfaces are red brick pavers, reflecting the area's historic architecture. While most sidewalks are relatively smooth, there were several areas with uneven walking surfaces that may create tripping hazards and challenges for pedestrians using assistive devices such as walkers or white canes.

Roadway crossings are provided in many, but not all, of the desired crossing locations. For example, the area around Memorial Circle can prove to be especially challenging for pedestrians and motorists alike. While many desire lines take pedestrians near or even through Memorial Circle, crossing facilities are set well back from the circle. While this design does not accommodate desired pedestrians crossing movements, it is appropriate for the current layout of the circle due to wide crossings, multiple and complex vehicle movements, and obscured sight lines. There is only one designated crossing on Main Street between Green Street and Church Circle (at Conduit Street), in spite of the density of destinations on both sides of the street.

The following paragraphs provide an overview of conditions for pedestrians at key locations throughout the study area.

- **Main Street**

  Sidewalks along Main Street are relatively wide (approximately 8-14 feet) and provide ample space for walkers during a typical weekday. However, they can become congested on weekends when the weather is good and tourists converge on the area. On-street parking on both sides of the street buffers pedestrians from motor vehicle traffic. Sidewalk cafes create a lively atmosphere, but they can also create pinch points when the sidewalks are crowded with pedestrians. There are designated crossings across Main Street for one leg of the intersection at Green Street/Market Place (north leg), Conduit Street (signalized/south leg) and Church Circle (signalized). Between Green Street and Church Circle, pedestrians 'weave' across Main Street, appearing from between parked cars at locations away from an intersection. Relatively low traffic speeds and volumes facilitate this behavior, and the volumes of crossing pedestrians may have an additional traffic calming effect. At Church Circle, a traffic light with pedestrian signals accommodates crossings of the circle, as well as Main Street. Pedestrians along Church Circle crossing Main Street have to contend with vehicles turning right on red into the circle, while there are no turning movements conflicting with pedestrians crossing the circle (as there are no right turns onto Main Street as it is one-way).

Main Street looking toward Church Circle

- **Randall Street**

  There is a small plaza on the north side of roadway, on the same parcel as the Market Place. While there is generally adequate space for pedestrians in the plaza area, the sidewalk along the Market Place is relatively narrow and can become congested when there are large volumes of pedestrians. On the

opposite side of the roadway, there is a pedestrian promenade between Randall Street and the City Dock. Generally, there is adequate space on the promenade to accommodate typical levels of activity. However, on one occasion, it was observed that the promenade was used as a staging point for a march to the State House, and pedestrians trying to bypass the crowd had difficulty navigating the area.

In an effort to prevent pedestrians from crossing Randall Street directly adjacent to Memorial Circle, chains and bollards have been erected. However, there is a very strong pedestrian desire line at this location and numerous people, including people with strollers and small children, were observed stepping over the chains in order to cross. There are marked crosswalks at the intersection of Randall Street and Dock Street, although the intersection is not signalized.

Randall Street looking toward Dock Street

East of Dock Street, the sidewalks on both sides of Randall Street are relatively narrow and are squeezed between building walls and the street. Street furniture (such as trash cans) and utility poles further constrains the sidewalks at critical locations including corners where pedestrians must queue to cross the street.

There is a signalized crossing at the intersection of Randall Street and Prince Georges Street. Crosswalks and pedestrian signals are provided on two of the four legs of the crossing.

- **Dock Street Parking Lot**

  The Dock Street surface parking lot is bounded on the south by a relatively wide pedestrian boardwalk along the water (approximately 8-10 feet) running the length of the City Dock. It connects to a pedestrian plaza at the harbor. Several stores, boutiques and restaurants occupy the north side of the parking lot. A relatively narrow sidewalk runs along the face of these stores, and there are constraints in several places due to sidewalk displays, street furniture and other obstructions. There is a relatively strong pedestrian desire line across the parking lot between the pedestrian boardwalk and the shops, and pedestrians were observed crossing the parking lot at multiple locations. The Harbor Master's office is located towards the middle of the parking lot.

- **Compromise Street**
  Compromise Street runs south towards Eastport and has sidewalks on both sides. Currently, the demand for enhanced pedestrian facilities is relatively low. However, future development on the western side of the City Dock area will likely increase pedestrian activity in this area.

Existing Conditions for Bicycles

There are no formal on- or off-road facilities for bicyclists in the study area. The Colonial Annapolis Maritime Trail is a designated route that runs from Eastport north and west along Compromise Street and Randall Street to King George, however only one sign was found indicating the trail's alignment. There is an older school-yard style bicycle rack on the Market Place plaza, and there is some bicycle parking near the Harbor Master's office. Bicycles were observed chained up to street signs, utility poles, trees and other objects. The Free-Wheelin' bike rental operation is run by the Harbor Master's office and has approximately 10 bicycles for rent.

Bicycle parking at Market Place

The slow traffic speeds and relatively low traffic volumes provides a comfortable bicycling environment for more experienced cyclists, and several were observed riding along Randall, Compromise and Main Street.

Discussions with City staff indicate that bicycle rentals have reached nearly 700 rentals during the 2009 season, but once a fee of $10 a day and $5 a half-day was initiated, rentals dropped to 77. In the 2011 season, the City plans to return to a free bicycle rental program and is also exploring a bicycle sharing program. Decreasing or eliminating the fees for this program will likely increase ridership and program popularity.

The existing pedestrian and bicycle environment is illustrated graphically in **Figure 7**.

Figure 7. Existing Pedestrian and Bicycle Environment

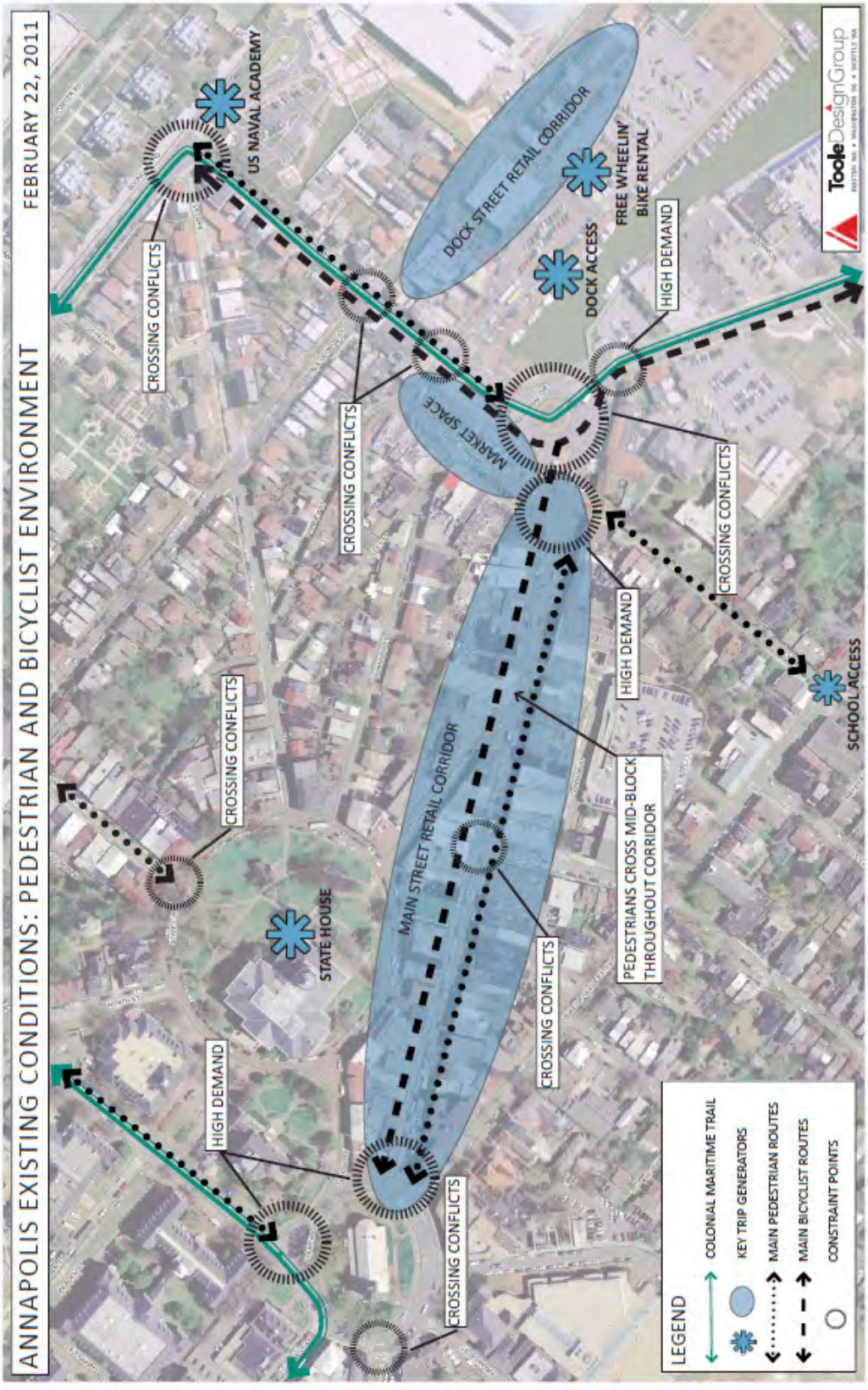
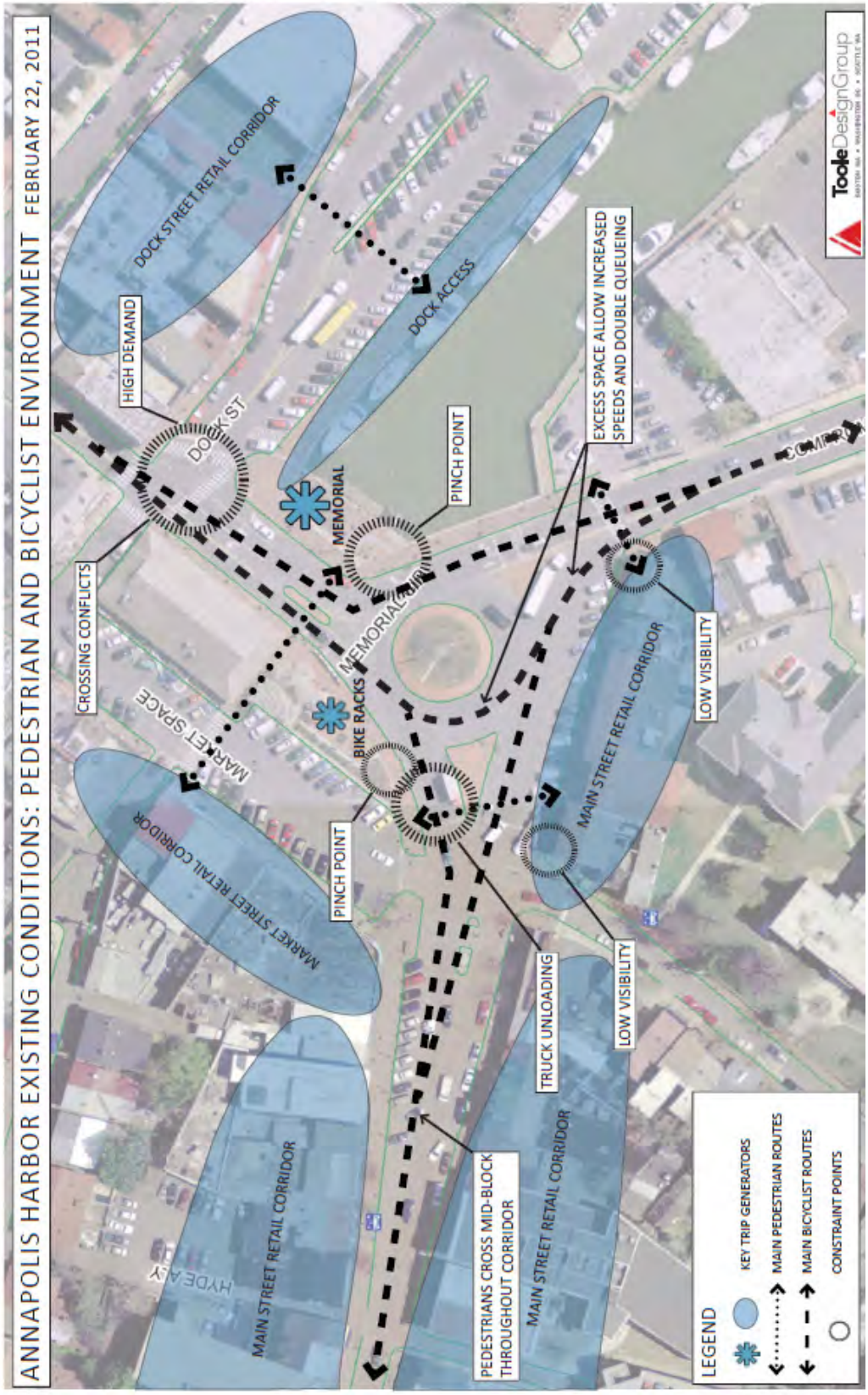


Figure 7 (continued). Existing Pedestrian and Bicycle Environment



3.5 Transit Services

Bus transit service in the study area is provided by two service providers: the City of Annapolis and the Maryland Transit Administration (MTA). In November 2010, the City revised its bus transit routes to enhance efficiency and improve transfers. City buses serve destinations throughout the City, MTA buses serve destinations throughout the region and shuttles serve the satellite parking facilities.

The downtown City Dock area is served by the State Shuttle, Navy Shuttle, Gold Line, Orange Line, Green Line, Purple Line, MTA Express Buses 922 and 950, and MTA Bus 14. City buses typically run from 5:30 AM to 7:00 PM Mondays through Saturdays on fixed headways which vary from 30 minutes to two hours. Limited evening and Sunday service is provided by the Purple Line. It should also be noted that the Navy Shuttle service is being eliminated on July 1st, 2011. A new downtown circulator will be implemented to service the downtown area and the City parking garage facilities. This service will run from 7:30 AM to 2:30 AM with a ten minute headway for a fare of $0.50, or free with a parking ticket.

Standard transit fares are currently $1.00 per ride; however, standard transit fares will be increased to $1.50 beginning on July 1st, 2011. The downtown shuttle from the Navy-Marine Corps Memorial Stadium is free with a valid state photo ID (Monday through Friday) or with a paid parking ticket from the Stadium. Residents can apply for Student Discount Stickers, which allow students between ages 12 and 18 to ride half-fare on all transit routes. Residents can also apply for Summer Youth Passes, which allow students ages 12 to 18 unlimited use of all Annapolis Transit routes at no cost.

Bus stops are located at 10 individual locations within the study area along College Avenue, King George Street, Bladen Street, West Street, Church Circle, Main Street and Compromise Street. Most locations provide only stop flags, but locations along Bladen and West Street provide shelters, benches and trash receptacles, and the locations at Church Circle provide benches.

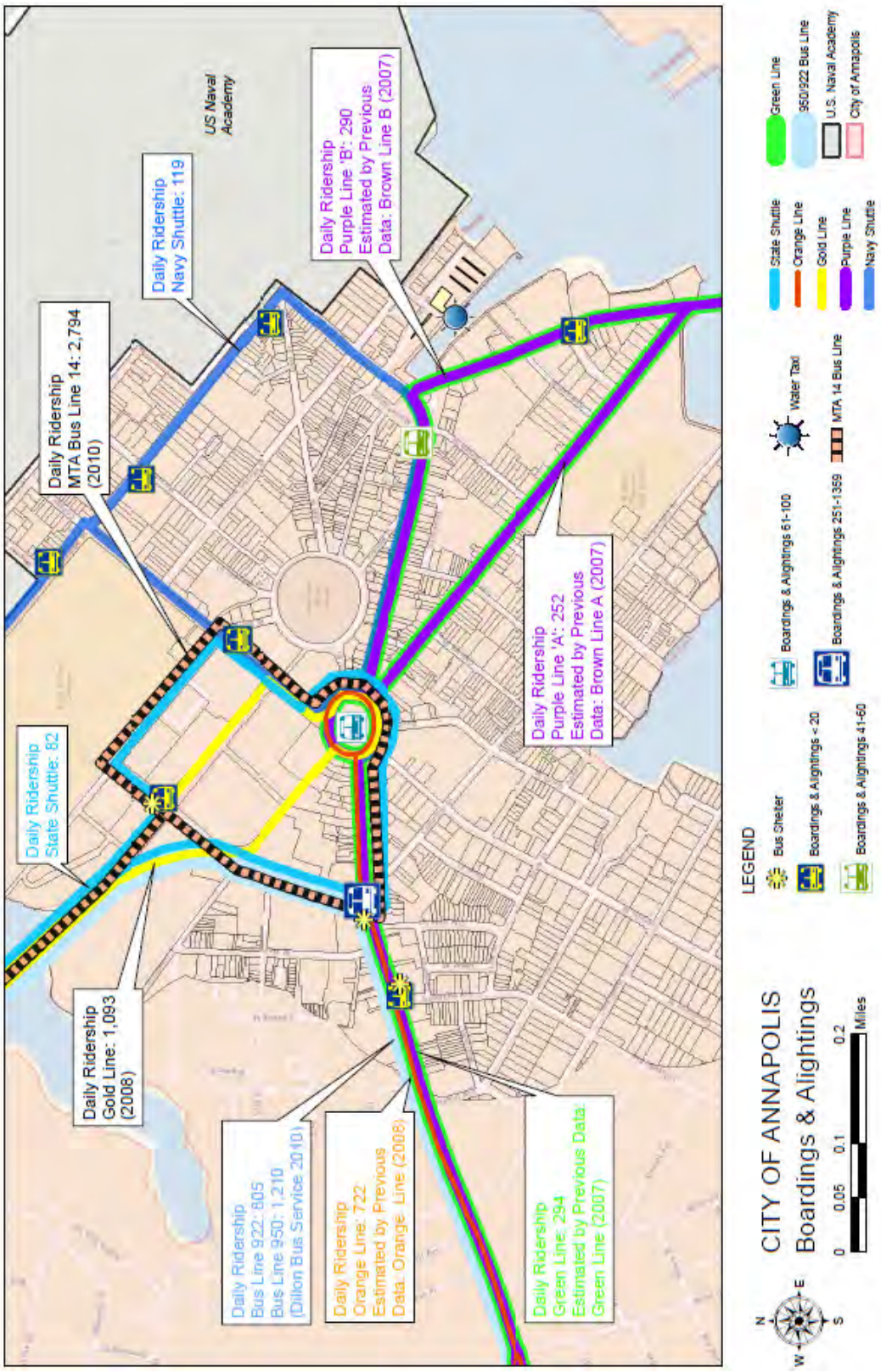
Limited informational signing is provided, and no real-time 'Next Bus' data is shown.

Ridership data was provided by the City and MTA and varies from less than 100 persons per day (State Shuttle) to 2,800 persons per day (MTA Bus 14). Boarding and alighting count data was also provided by the City. All bus stops were documented at less than 20 boardings or alightings per stop per weekday, with the exception of City Dock, Church Circle and West Street at Calvert Street which had over 1,350 daily transit patrons.

A water taxi service operates during warmer months for $2.00 a ride to and from the City Dock and other commercial and recreational points on the Spa and Back Creeks.

Figure 8 illustrates the existing transit routing, ridership, bus stops and bus stop usage in the study area.

Figure 8. Existing Transit Service and Usage



3.6 Cordon Line Analysis

A cordon line is defined as an imaginary boundary drawn around a study area. A cordon line analysis aggregates all traffic across this line, and provides a global-level snap shot of traffic flows into and out of the study area over a specified time period. It captures distribution in traffic patterns (e.g. inbound versus outbound flow), vehicle classifications (e.g. automobiles versus trucks) and modes of travel (e.g. auto, bus, bicycle, pedestrian).

A cordon line analysis of the study area was evaluated to determine the existing mode share entering the downtown City Dock area in the morning and exiting the study area in the afternoon. Vehicular, pedestrian and bicycle volumes were aggregated at the following major intersections crossing of the study area boundary:

- Rowe Boulevard/ Northwest Street at Calvert Street
- Bladen Street at Calvert Street
- King George Street at College Avenue
- West Street at Calvert Street/ Cathedral Street
- Compromise Street at Duke of Gloucester Street

In addition, transit boarding, alighting and ridership counts provided by the city for local and regional bus routes serving the downtown City Dock area were also included.

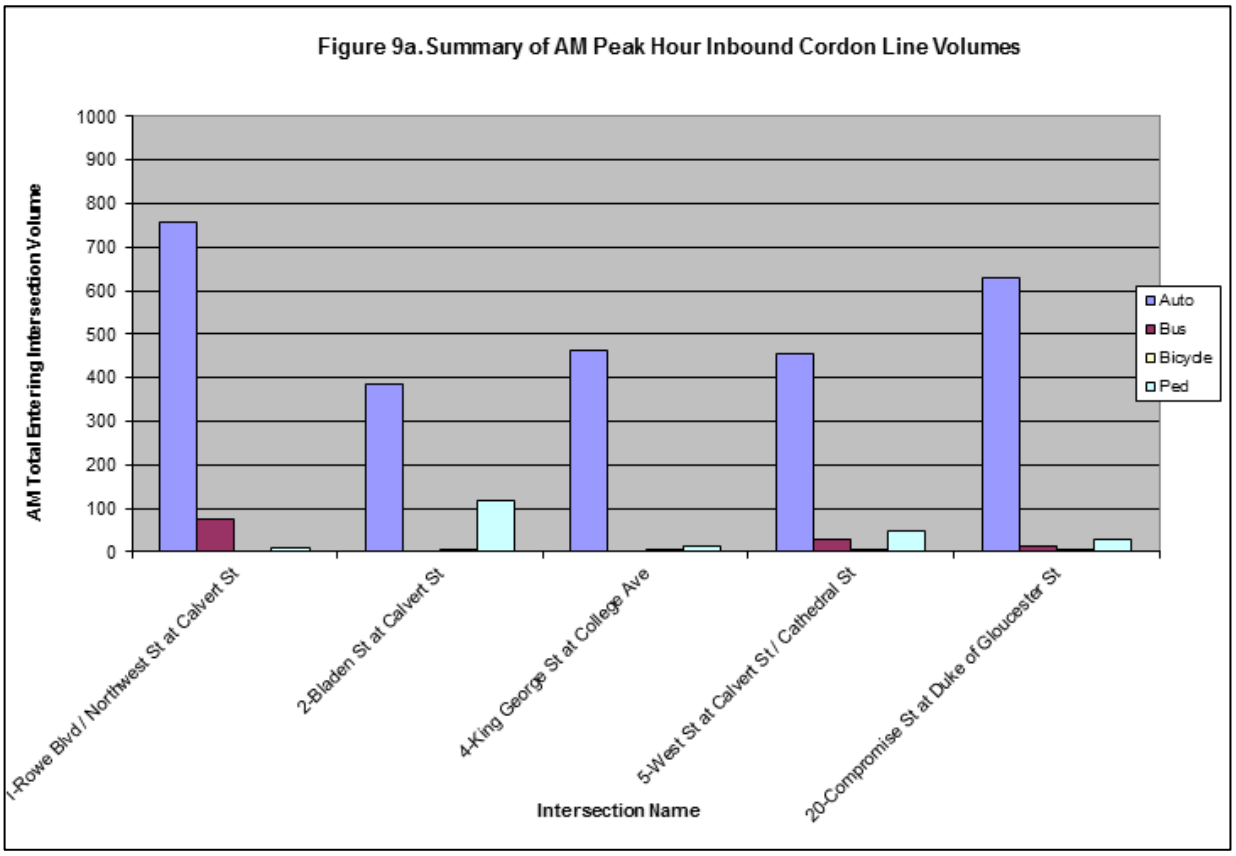
The results of the analysis indicated that, without adjusting for automobile occupancy, 3,052 AM peak hour trips entered into the study area, and 3,162 PM peak hour trips exited the study area. The mode share was predominantly private automobile – accounting for approximately 90% of all trips, followed by pedestrian (approximately 7%), bus (approximately 3.0%), and bicycle (less than 0.5%). This range is fairly typical of a city the size of Annapolis and without major rapid transit service. The cordon line data should serve as a good baseline for measuring future progress in encouraging more trips by walking, biking and transit.

The cordon line analysis is summarized in Table 1 below, and illustrated graphically in **Figures 9a and 9b**, detailed cordon line data is included in **Appendix D**.

Table 1. Cordon Line Analysis Summary

INTERSECTION NAME	Weekday Peak Hour Inbound AM Intersection Volume					
	Auto	Truck	Bus	Bicycle	Ped	Total
1-Rowe Blvd / Northwest St at Calvert St	759	6	75	0	10	850
2-Bladen St at Calvert St	384	0	0	1	119	504
4-King George St at College Ave	463	0	0	1	15	479
5-West St at Calvert St / Cathedral St	456	9	28	3	48	544
20-Compromise St at Duke of Gloucester St	630	1	14	3	27	675
Totals	2692	16	117	8	219	3052
Percent Mode Share	88.2%	0.5%	3.8%	0.3%	7.2%	100%

INTERSECTION NAME	Weekday Peak Hour Outbound PM Intersection Volume					
	Auto	Truck	Bus	Bicycle	Ped	Total
1-Rowe Blvd / Northwest St at Calvert St	0	0	0	0	3	3
2-Bladen St at Calvert St	1161	2	35	1	41	1240
4-King George St at College Ave	431	0	0	3	36	470
5-West St at Calvert St / Cathedral St	377	1	28	3	131	540
20-Compromise St at Duke of Gloucester St	884	0	23	2	0	909
Totals	2853	3	86	9	211	3162
Percent Mode Share	90.2%	0.1%	2.7%	0.3%	6.7%	100%



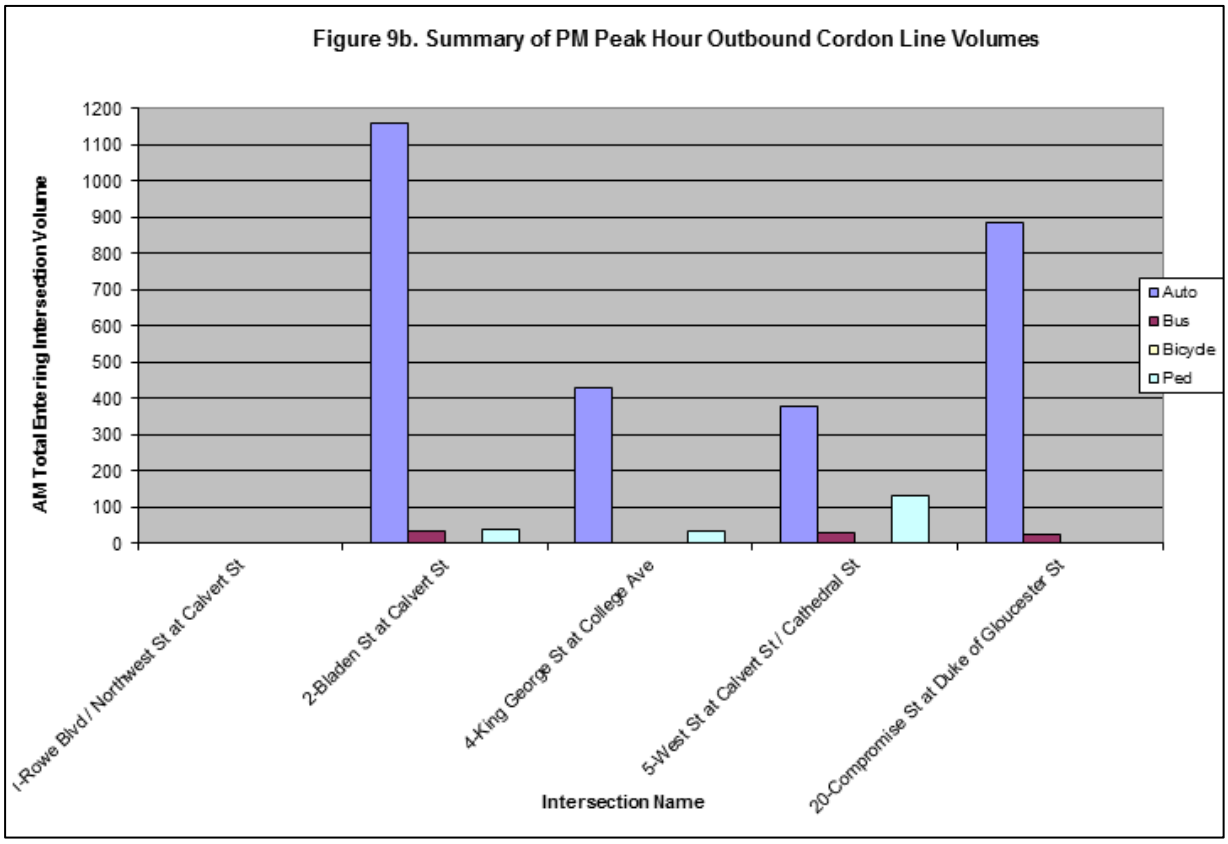


Figure 9b. Summary of PM Peak Hour Outbound Cordon Line Volumes
AM Total Entering Intersection Volume
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
Auto
Bus
Bicyde
Ped
1-Rowe Blvd / Northwest St at Calvert St
2-Bladen St at Calvert St
4-King George St at College Ave
5-West St at Calvert St / Cathedral St
20-Compromise St at Duke of Gloucester St
Intersection Name

4.0 SAFETY ANALYSIS

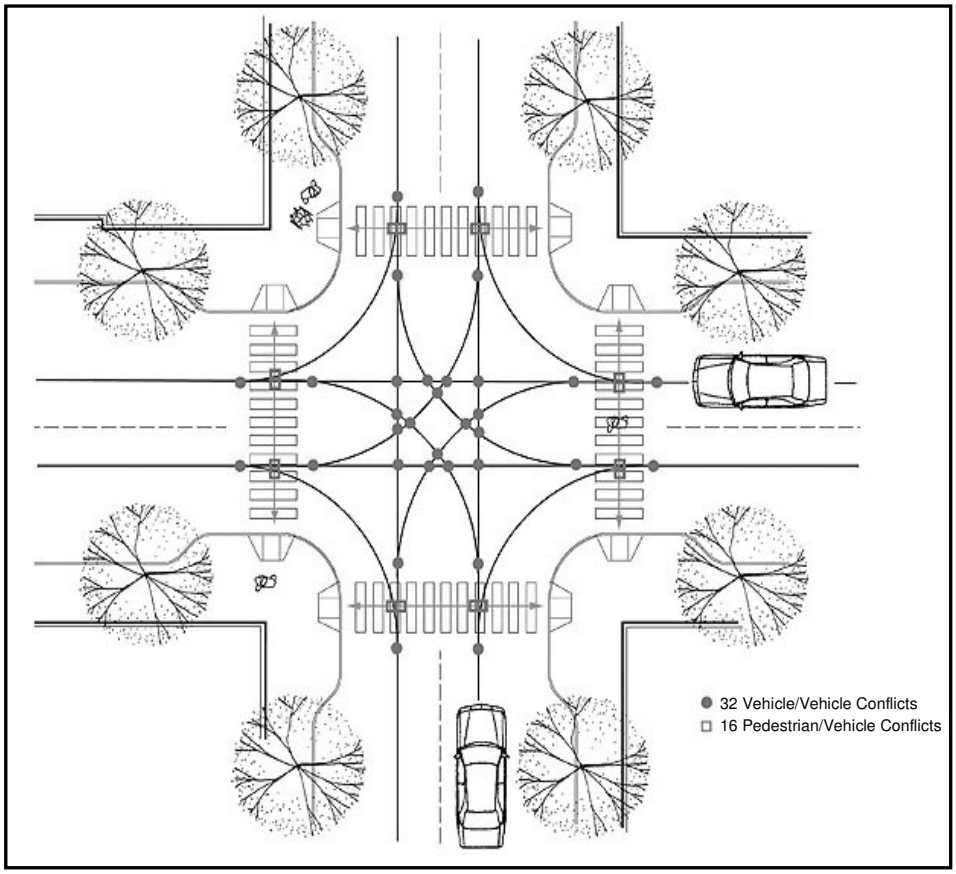
To further assess the existing transportation network, a detailed analysis of safety conditions was performed including conflict points, field observations of risky behaviors by motorists, pedestrians, and bicyclists, as well as a review of available crash data and reports.

4.1 BAPSE Methodology

Exclusively for this study, a unique methodology was created to identify and target critical conflict points and safety hazards in the study area. The methodology was designed to be a planning-level analysis that could be easily transferred to other areas outside the downtown City Dock area. The methodology is based on a conflict point assessment at each of the study intersections, followed by a cross-product analysis.

As shown in **Figure 10**, at a typical four-leg intersection there are over 32 vehicle-vehicle conflict points, where multiple vehicles could desire to cross the same point simultaneously. Additionally there are 16 vehicle-pedestrian conflict points.

Figure 10. Intersection Conflict Point Diagram



As part of the traffic data collected for this study, peak hour directional turning movements were tabulated for each approach and intersection crossings were documented for both vehicles and pedestrians.

The BAPSE methodology used the conflict point assessment to identify the relevant conflict points at each intersection, and then tabulate the total traffic volumes at each point.

With the critical conflict locations known – the places where pedestrians and vehicles compete for shared space – a more thorough safety audit of each location was then performed based on Federal Highway and Maryland State Highway best practice including conflict cross-product calculations; review of field geometry; traffic controls; motorist, pedestrian and bicycle risky behaviors; and a review of reported crash data. The result of the safety audit is the development of a menu of mitigation options and recommended safety countermeasures for the downtown City Dock area that form the basis of the final recommendations in this study.

The evaluation of conflict cross-products, risky behaviors and crash data review is discussed in more detail in subsequent sections.

4.2 Cross-Product Analysis

A cross-product calculation was performed for each vehicle-pedestrian conflict point. The calculation multiplied the vehicle volume times the conflicting pedestrian volume to identify intersections and crosswalks with the highest quantified number of hourly or total conflicts.

An example of the cross-product approach is illustrated in **Figure 11a**. The example calculation is shown in **Figure 11b** which compiles the Saturday vehicular and pedestrian volume data for each turning movement and crosswalk. The highest cross-product at the intersection was found to be on the south leg, where 450 pedestrians crossed in the busiest hour, and conflicted with 72 northbound left-turns, 211 southbound through vehicles, 237 northbound through vehicles, 45 westbound left-turning vehicles and 177 northbound right-turning vehicles. Thus the total cross-produce for that leg of the intersection = 450 x (72+211+237+45+177) = 333,900. This value was the highest of any leg at the intersection.

Figure 12 shows the application of this methodology across all study intersections. This figure clearly illustrates that the highest cross-product locations are either immediately adjacent to the City Dock or at Church Circle. Detailed cross-product worksheets can be found in **Appendix E.**

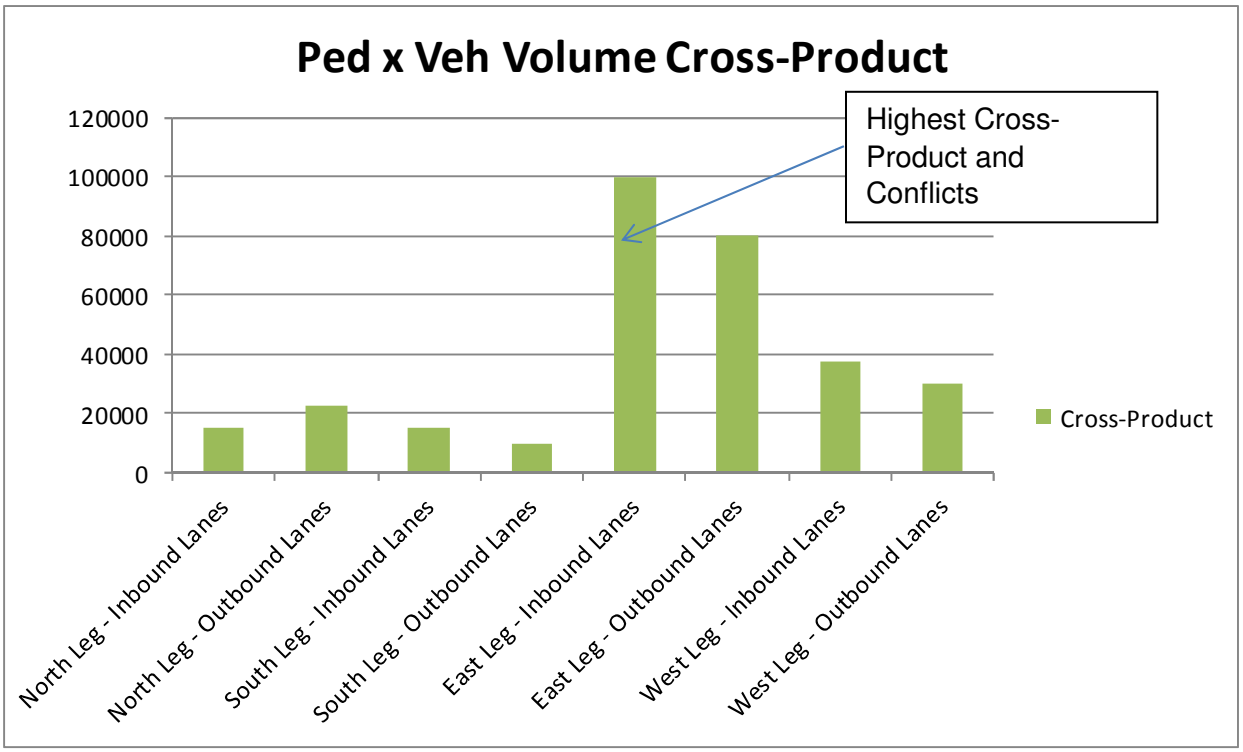
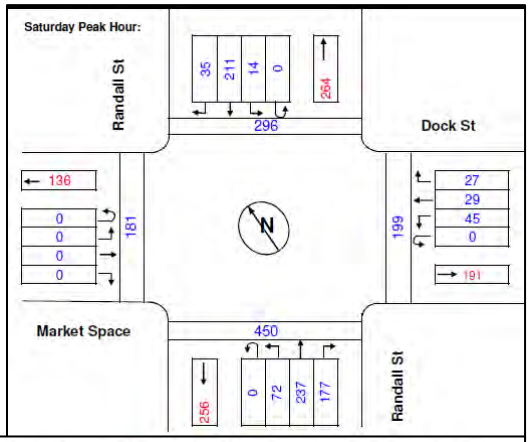


Figure 11a. Example Cross- Product Intersection Summary

Figure 11b.
Randall Street at Dock Street Intersection Cross-Product Calculation



Legend: LT Phasing = Left Turn Phasing; RT Phasing = Right Turn Phasing; RTOR = Right Turn on Red
LTOR - Left Turn on Red (at one-way intersections only), E-P = Exclusive-Permissive

X-Walk Leg:	Conflicting Lefts (L) (see notes)	Conflicting Rights (R) (see notes)	Conflicting Thrus (T) (see notes)	Total Conflicts TC = L + R + T	Pedestrians P (from above)	Cross Product CP = TC x P
WEEKDAY AM PEAK HOUR						
North	1	9	724	734	17	12,478
South	60	78	724	862	18	15,516
East	15	82	11	108	10	1,080
West	46	5	11	62	11	682
WEEKDAY PM PEAK HOUR						
North	8	14	678	700	149	104,300
South	64	70	678	812	85	69,020
East	32	78	7	117	73	8,541
West	40	6	7	53	39	2,067
SATURDAY PEAK HOUR						
North	14	62	448	524	296	155,104
South	117	177	448	742	450	333,900
East	59	204	29	292	199	58,108
West	72	35	29	136	181	24,616
					Total Intersection Cross Product:	**785,412**

Figure 12. Vehicle X Pedestrian Volume Cross-Product Summary

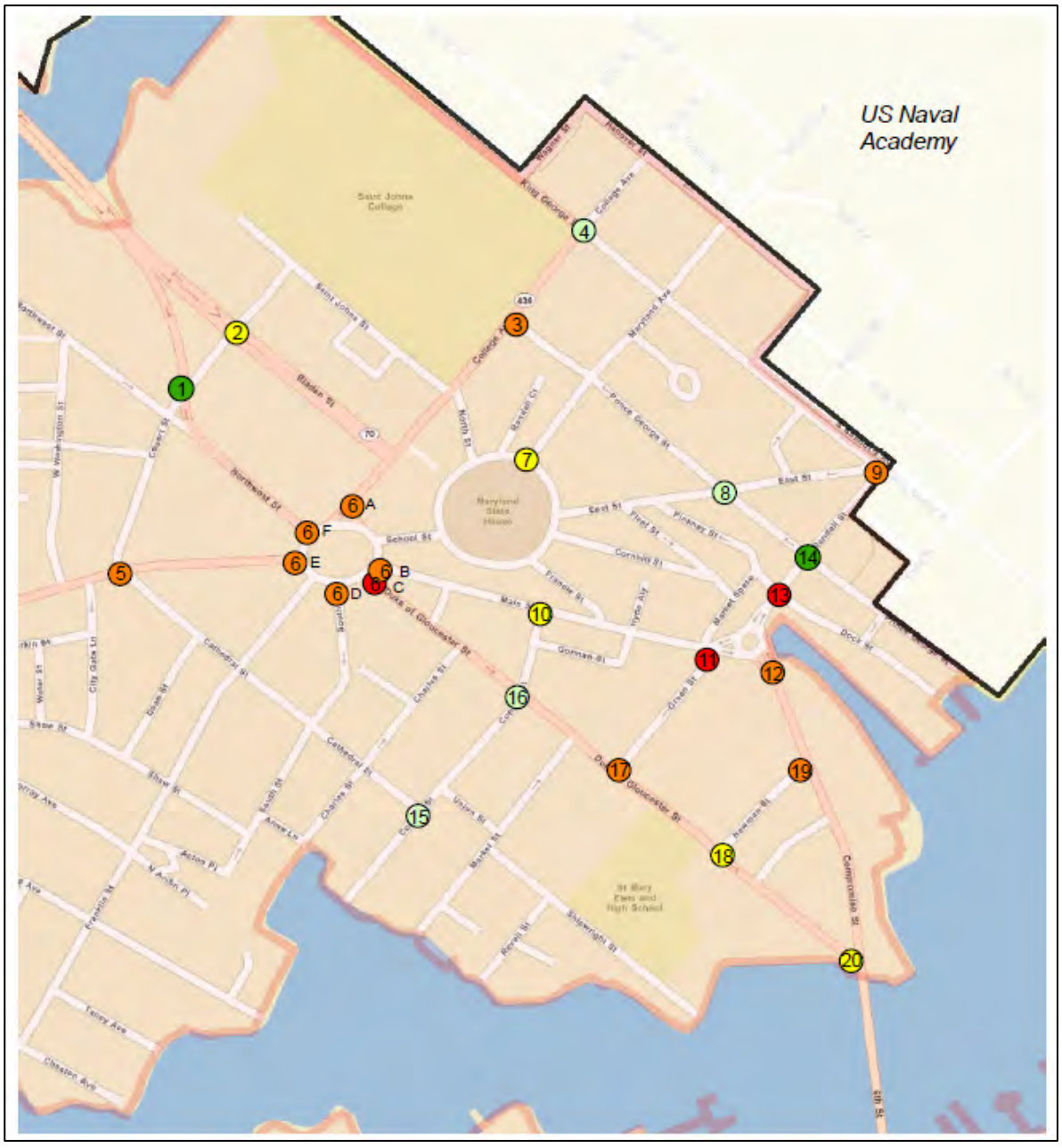
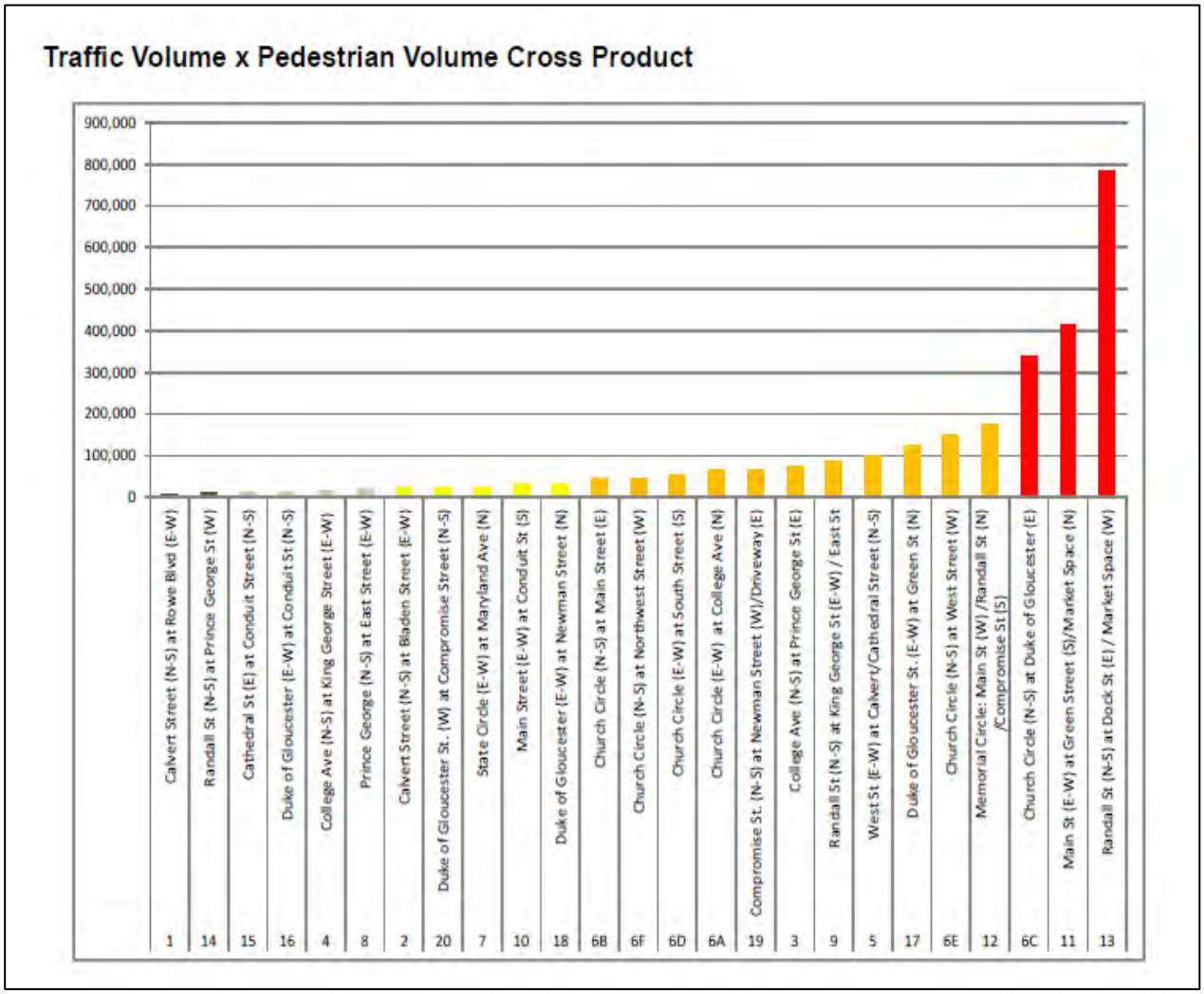


Figure 12 (continued). Vehicle X Pedestrian Volume Cross-Product Summary



4.3 Field Observations

In order to more comprehensively assess and understand the interactions between various modes at critical conflict points, and validate how traffic operations and roadway characteristics may affect safety trends, engineers were stationed to observe driver, pedestrian and bicycle risky behaviors. Observations were conducted during a typical weekday during peak and off-peak hours, as well as during Saturday peak hours.

General observations focused on the following key issues:

1. Are motorists doing anything that negatively affects traffic flow?

2. Are pedestrians/ bicyclists doing anything that negatively affects traffic flow?

3. Is traffic backing up anywhere and why?

4. Are traffic control devices (signals, signs, light fixtures and markings) working and visible?

In addition to general observations, specific observations of risky driver, pedestrian and bicycle behaviors were tallied at each of the study intersections, including:

Driver Behaviors:
1. Bus or parking maneuver blockage
2. Blocking the intersection
3. Blocking driveways
4. Illegal U-turns
5. Left turn violation
6. Right turn violation (existing no turn on red)
7. Red light running
8. Encroachment into crosswalk (none, full, partial)
9. Conflict / Failure to yield right-of-way to pedestrian or bicycle in crosswalk

Pedestrian Behaviors:
1. Not in crosswalk but crossing near intersection
2. Not pushing button and/ or crossing on don't walk
3. Pushing button and then crossing on don't walk
4. Pedestrians crossing on red if no pedestrian signal indication is present
5. Distracted pedestrians - talking on cell phones while crossing
6. Pedestrians standing in the street or parking lane waiting to cross instead of behind the curb or on the corner

7. Pedestrians standing in the path (or too close to the corner) when large vehicles are turning
8. Pedestrians crossing outside of the crosswalk midblock or away from intersection
9. Pedestrians walking between cars queued at intersections
10. Pedestrians walking in the street NOT facing traffic
11. Diagonal pedestrian crossings
12. Pedestrians getting off the bus and then crossing in front of the bus before it leaves the stop
13. Drunk pedestrians
14. Segways on sidewalk
15. Disabled pedestrians; motorized scooters; and associated behaviors

Bicycle Behaviors:

1. Riding on sidewalk
2. Riding from sidewalk and entering intersection crosswalk at higher speed than pedestrians
3. Weaving between queued vehicles
4. Riding in the blind spot (right side or rear left side) of heavy vehicles or buses
5. Diagonal crossings between vehicles
6. Difficultly navigating brick pavers
7. Bicyclists weaving from door zone of parking lane into traffic lane
8. Riding two or more abreast instead of single file and impeding the flow of traffic
9. Rolling through stop signs and stop lights
10. Riding the wrong way on a one way street
11. Riding facing traffic instead of riding with the flow of traffic
12. Under 16 with no helmet
13. Extra passenger riding on handlebars
14. No reflective equipment in bad weather

A highlight of some key observations is summarized below. The most commonly observed risky behaviors included drivers blocking the intersection and encroaching into the crosswalk; distracted pedestrians, pedestrians waiting in the street to cross, crossing diagonally and crossing outside of the crosswalk; and bicyclists riding on the sidewalk, entering intersections at high speeds, and rolling through stop signs and signals.

City Dock Area

- The City Dock is brimming with pedestrian activity, with residents, tourists and workers walking throughout the area. In many cases, pedestrians were observed taking the most direct route to their destinations, regardless of the presence or absence of a designated crossing. A significant number of pedestrians did not

use marked crosswalks. A few pedestrians were observed crossing the intersection diagonally.

- **Memorial Circle** was often blocked by vehicles queued from downstream intersections along Main Street and Randall Street during the peak periods on weekdays and Saturday. Westbound traffic along Main Street was observed to back up into Memorial Circle on several occasions. Northbound traffic along Randall Street was observed to back up into Memorial Circle on several occasions.
- A few jaywalkers were observed. Some of these jaywalked to the center of **Memorial Circle**.
- Pedestrians were observed walking between cars queued at Randall Street and City Dock, as well as **Memorial Circle**.
- People backing out of parking spaces within **Memorial Circle** blocked traffic. Crossing guards stopped traffic for them.
- Many vehicles were observed not to yield to circulating traffic in **Memorial Circle**.
- A "multiple threat" conflict was observed on Compromise Street at the crosswalk approaching **Memorial Circle**. Drivers approaching in one lane sometimes yield to pedestrians at a location that impedes sight distance between pedestrians and drivers in the other lane.
- Youths crossed the circulating roadways of **Memorial Circle** on skateboards and used the center island or the roundabout as a skateboard ramp. Skateboards were also seen on sidewalks.
- Some vehicles failed to yield right-of-way to pedestrians and bicycles in crosswalks at the intersections adjacent to City Dock.
- Pedestrians were also observed crossing from Market Place to the City Dock across **Randall Street**, circumventing bollards and chains intended to prevent this activity.
- Pedestrians were observed walking in the street along **Randall Street** and Main Street NOT facing traffic.
- Left-turning vehicles exiting Dock Street at **Randall Street** were observed to have limited sight distance and accept less than adequate gaps, occasionally causing motorists on Randall Street to brake suddenly.
- Motorized scooters were observed on all streets in the City Dock area, some without helmets.
- A crossing guard is present for the crosswalk on the west leg of **Main Street** at Green Street to assist in the dismissal of schoolchildren from Annapolis Elementary School on Green Street. During this time, traffic backs up around Memorial Circle and its approach legs when the guard stops traffic. Parents in parked cars were observed waiting to pick up schoolchildren in the parking areas around the Circle.

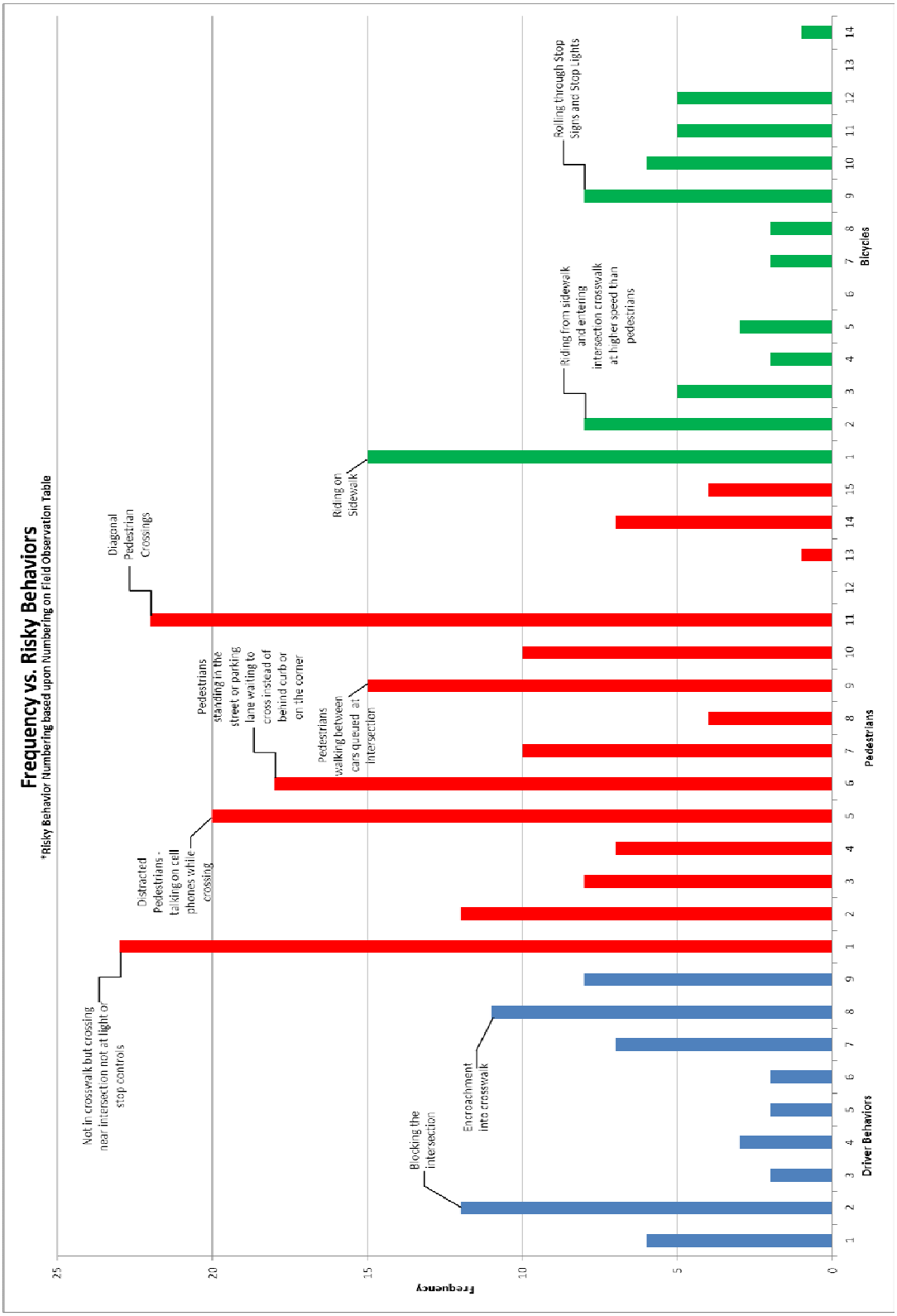
- Pedestrians crossed to the curb island east of the intersection of Green Street and **Main Street** to take refuge and waited for a break in traffic to cross to the other side.
- A few pedestrians were observed crossing while talking on cell phones.
- Pedestrians were observed waiting in the street or parking lane instead of behind the curb or on the corner along **Main Street**.
- Vehicles fully and partially encroached into the crosswalk.
- A few Segways were observed on the sidewalks.
- Due to the cool weather during the data collection period, relatively few bicyclists were observed. However, more than one bicyclist was observed riding on the sidewalks along **Main Street**, and several bicyclists were observed riding counterflow in the vehicle travel lane on Main Street. Cyclists were also observed riding counterflow within Memorial Circle traffic circle to make the left turn onto Randall Street.

Other Intersections:

- Duke of Gloucester Street at Green Street: Eastbound traffic backs up due to school drop off between 7:30 and 7:45 AM.
- Randall Street at Prince George Street: Limited sight distance was noted for right turns onto Randall Street from northwest-bound Prince George Street.
- Duke of Gloucester Street at Conduit Street: Limited sight distance was noted for right turns onto Conduit Street from Duke of Gloucester.
- College Avenue at King George Street: Limited sight distance was noted for the right turn on red for the southwest-bound turn from College Avenue to King George Street.
- College Avenue at Church Circle: Trucks going northbound on College Avenue from Church Circle made wide turns, and sometimes encroached on the double yellow centerline.
- Main Street: Pedestrians were observed crossing midblock throughout the length of Main Street.
- West Street at Church Circle: Drivers turning right on red from West Street to Church Circle encroached into the crosswalk and were distracted from yielding to pedestrians while looking for a gap in the Church Circle traffic. A near-miss pedestrian collision was observed due to this phenomenon.
- State Circle at Maryland Avenue: Sight distance between pedestrians and motor vehicles at the crosswalk across State Circle near Maryland Avenue is limited by parked cars.
- All Intersections: Bicyclists were observed weaving from the ‘door zone’ of the parking lane into traffic lane.
- All Intersections: Bicyclists were observed rolling through stop signs and traffic lights.

Figure 13 illustrates the frequency of the above noted risky behaviors across all study intersections. Detailed field observation checklists are included in **Appendix F**.

Figure 13. Frequency vs. Risky Behaviors



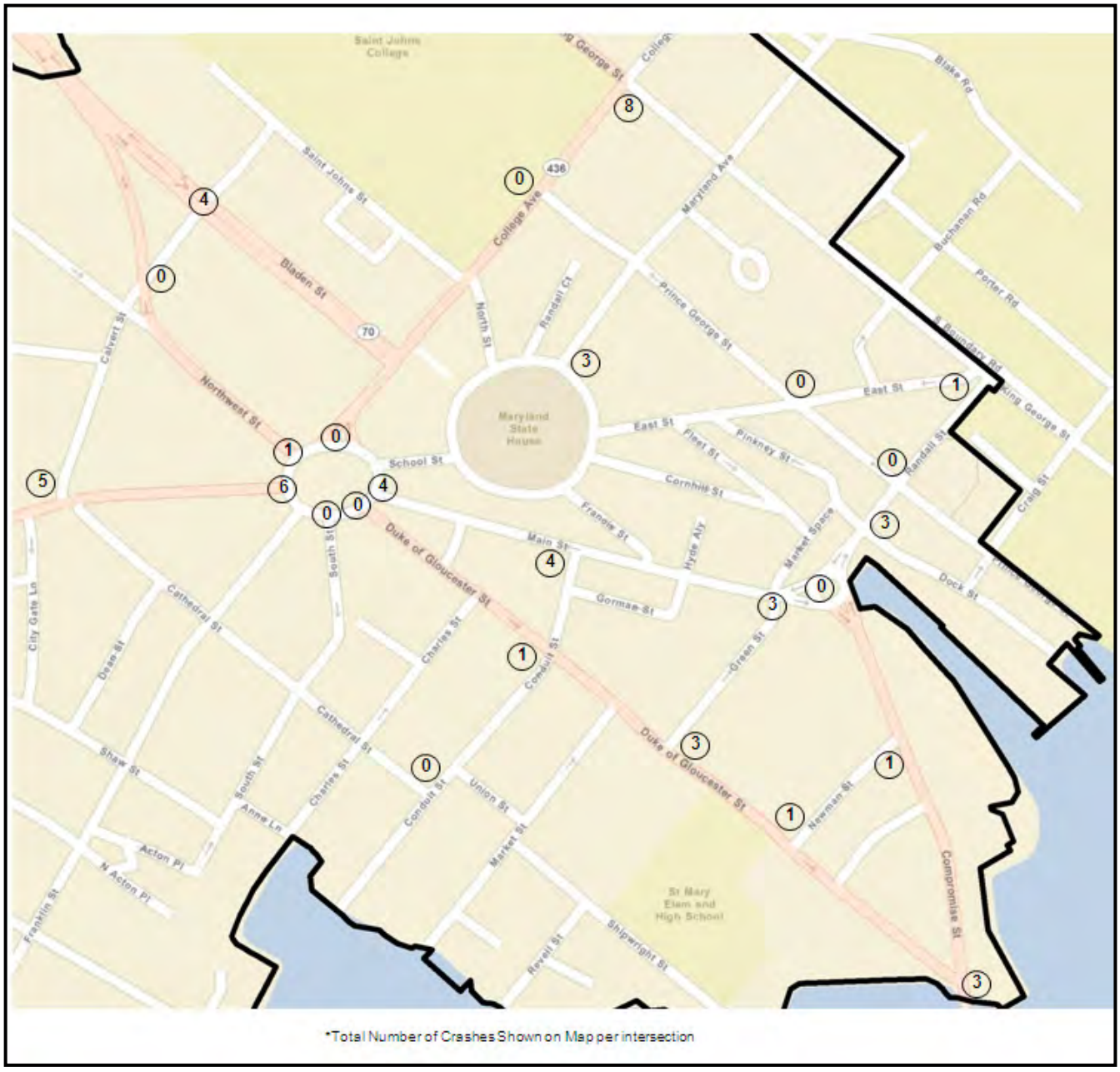
4.4 Crash Analysis

The crash analysis is based on data provided by the City of Annapolis and the Maryland State Highway Administration's Office of Traffic and Safety, Traffic Safety Analysis Division. It spans the time period from January 1, 2007 to December 31, 2009. The crash data was reviewed to identify dominant trends of crashes and the probable causes thereof and correlate those findings with existing intersection geometrics as well as physical road and operational characteristics. Notable findings include:

- There were a total of fifty-one police-reported crashes at all of the subject intersections over the three-year period.
- Thirty-five of those crashes (69%) were property-damage only, the other sixteen (31%) were injury. No fatalities were reported
- The predominant crash type was rear-end, which occurred seventeen times. Only five pedestrian crashes were reported. Other crash types included eight side swipes, seven angles, three fixed objects, one left-turn, six parked vehicles, and four unknown
- The number of crashes is decreasing – twenty-three in 2007, fifteen in 2008, and thirteen in 2009
- Crashes occurred most frequently in the midday (noon to 6 PM) – twenty-four, followed by the morning (6 AM to noon) – ten, followed by the evening (6 PM to midnight) – ten, followed by the nighttime (12 PM to 6 AM) – eight
- The reported probable causes were: failure to give full attention (twenty-three), failure to obey signal/ yield sign (two), fell asleep (one), followed too closely (one), improper passing (one), improper turn (one), too fast for conditions (one), influence of drugs (one), wrong way (one), and other (nineteen)
- Nine intersections reported zero crashes: Calvert Street at Rowe Blvd, College Ave at Prince George St, Church Circle at College Ave, Church Circle at Duke of Gloucester ,Church Circle at South Street, Prince George at East Street, Memorial Circle: Main St/Randall St/Compromise St, Randall St at Prince George St, Cathedral St at Conduit Street

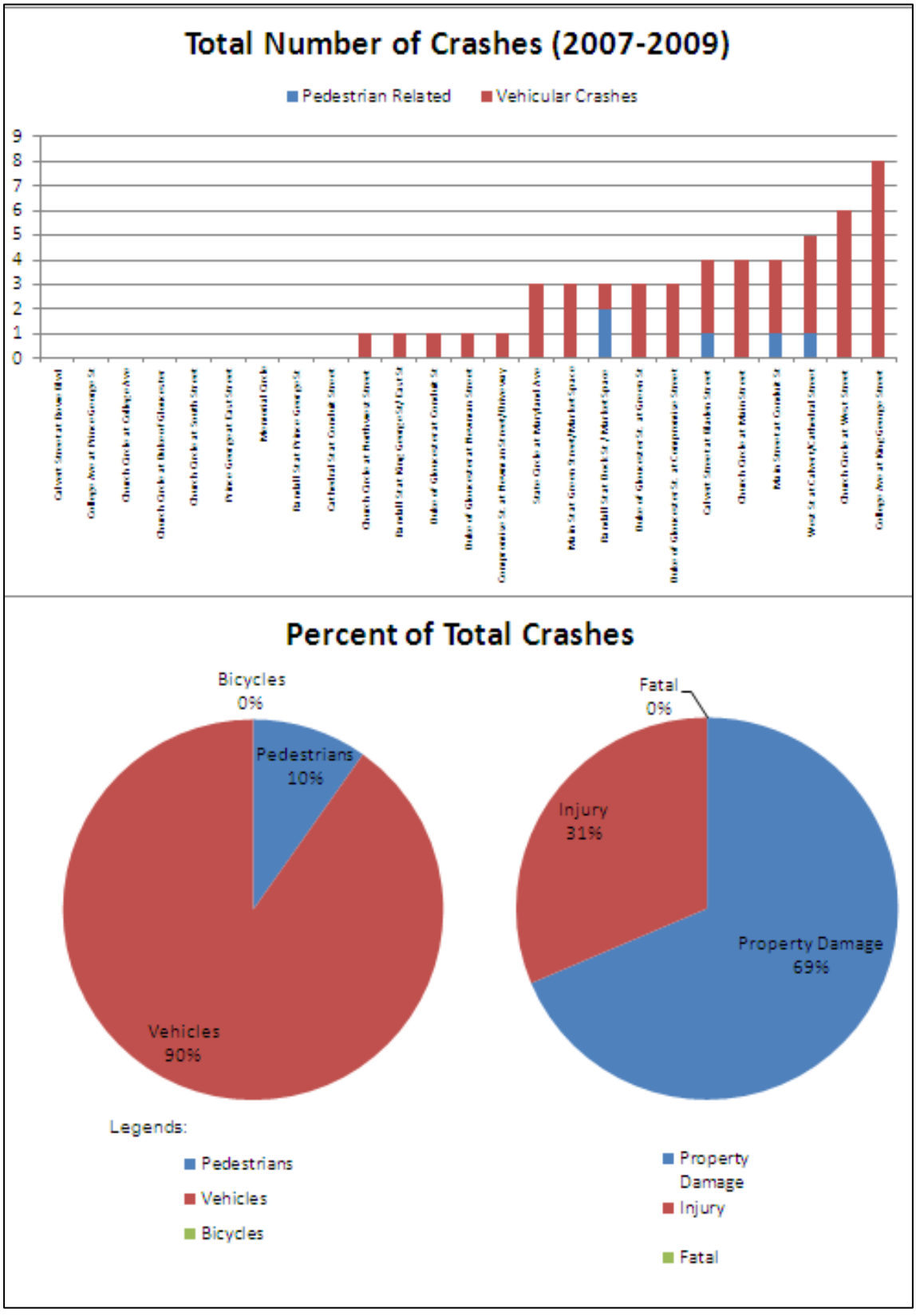
The crash data is illustrated graphically in **Figure 14**. Detailed crash reports are included in **Appendix G**.

Figure 14. Crash Data Summary



*Total Number of Crashes Shown on Mapper intersection

Figure 14 (Continued). Crash Data Summary



5.0 PARKING ANALYSIS

A comprehensive assessment of existing off-street parking supply, utilization, access, informational signing, management as well as on-street parking regulations was performed in order to further understand parking supply and demand in the study area. A field survey of off-street parking facilities was performed to verify the number of spaces, weekday and weekend utilization, access points, wayfinding signing, parking rates, and priority parking provisions (bicycle, carpools, vanpools, car shares, etc.)

5.1 Parking Facilities

Within the study area there are 10 public off-street parking facilities providing 2,969 parking spaces. Of the 10 facilities, all are operated by the City, with the exception of the Whitmore Garage (County-operated), Green Street lot (operated by the Board of Education) and Bladen Street Garage (State-operated). This excludes satellite parking lots including the Navy Stadium (5,000 spaces), Knighton Garage (300 spaces), West Garrett Garage (288 spaces), and Park Place Garage (800 spaces) – an additional 6,388 parking spaces. Parking is also available on-street, at metered parking spaces and along residential streets, for limited durations without a parking permit.

The existing off-street parking facilities are illustrated in **Figure 15**.

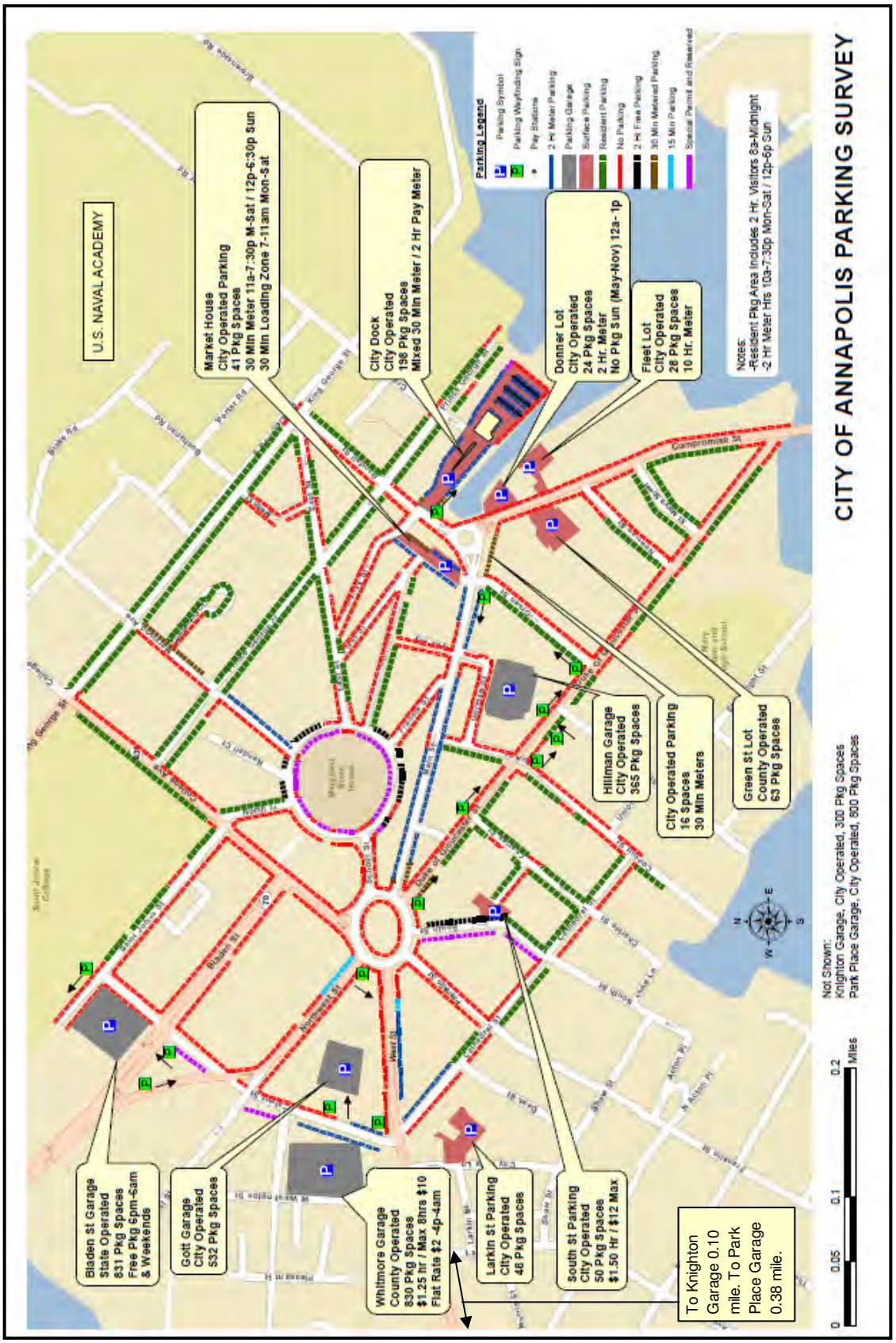
5.2 Curbside Management

Existing on-street parking spaces and regulations were also inventoried for every block within the study area. The purpose of the inventory was to document the existing curbside usage, parking regulations, and parking configurations for all roadways. Curbside needs vary based on trip purpose, duration of stay, cost of time, and feasibility to switch to other modes (e.g., someone coming to the downtown area to buy a piece of furniture or other large item would not be able to return home using public transit). A careful review of existing curbside regulations (e.g. permit, loading zones, meter limits, etc.) was documented to identify any possible way to improve the management of curbside space.

Of the approximate 100 block faces within the study area, only 12 along Main Street, Market Space, West Street, Maryland Avenue and Calvert Street provide metered parking. The remainder are residential, special permit or fully restricted parking. This is a relatively low percentage of total on-street parking that is fully open to the public and may be well below what a typical visitor traveling into the downtown City Dock area might expect.

At a cursory review, truck loading in the City Dock area also appeared ad-hoc; trucks were observed to double park in travel lanes (against the flow of traffic) and in medians.

Figure 15. Existing On- and Off-Street Parking Survey



5.3 Parking Utilization

A parking utilization survey was performed on Wednesday, November 10, 2010 and Saturday, December 11, 2010 for all off-street facilities as well as the Market Space meters. One pass was made through each location during the midday period (11:00 AM to 2:00 PM). The total number of parked vehicles was then compared to the total number of available on-street spaces to calculate a utilization rate. The parking utilization rates are summarized in **Figure 16**, detailed field parking survey worksheets are including in **Appendix H**.

Overall, weekday daytime utilization rates are near 100% for most facilities, due to the demand by downtown workers. The City Dock, Market Space, Whitmore and Larkin Street facilities all had 20 to 30% excess capacity.

On the weekend, only the facilities immediately adjacent to City Dock – the City Dock lot, Fleet, Donner and Market Space facilities were near capacity. No other facility with the exception of South Street exceeded 50% capacity.

The imbalance suggests that visitors and shoppers may not be aware of other parking options during off-peak hours such as evenings and weekends.

Figure 16. Existing Peak Parking Utilization Summary

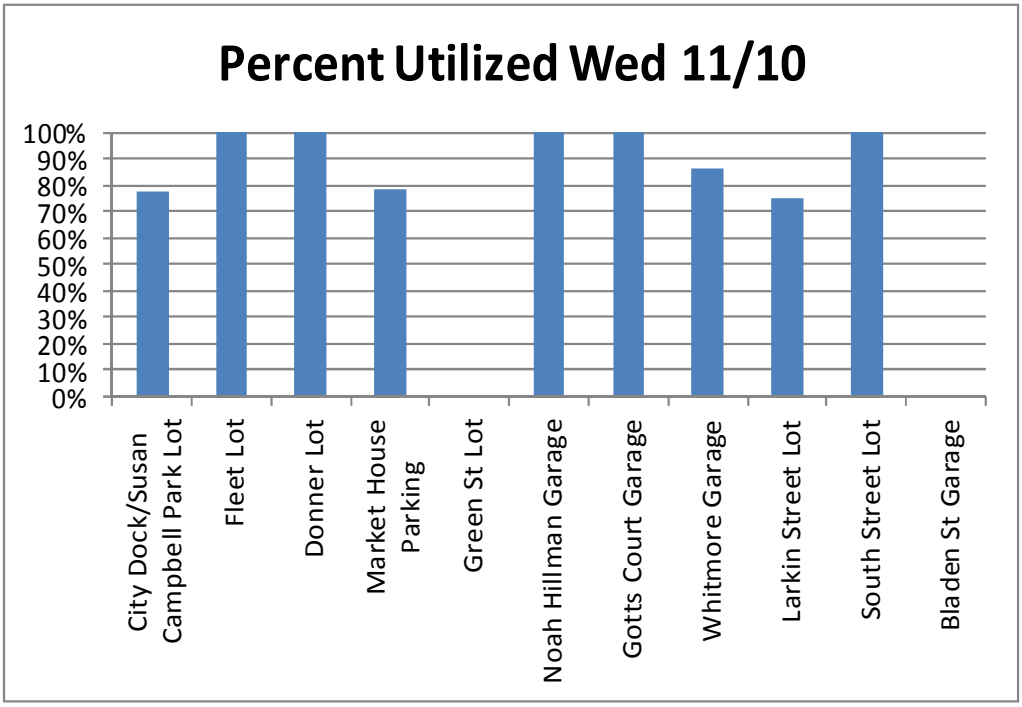
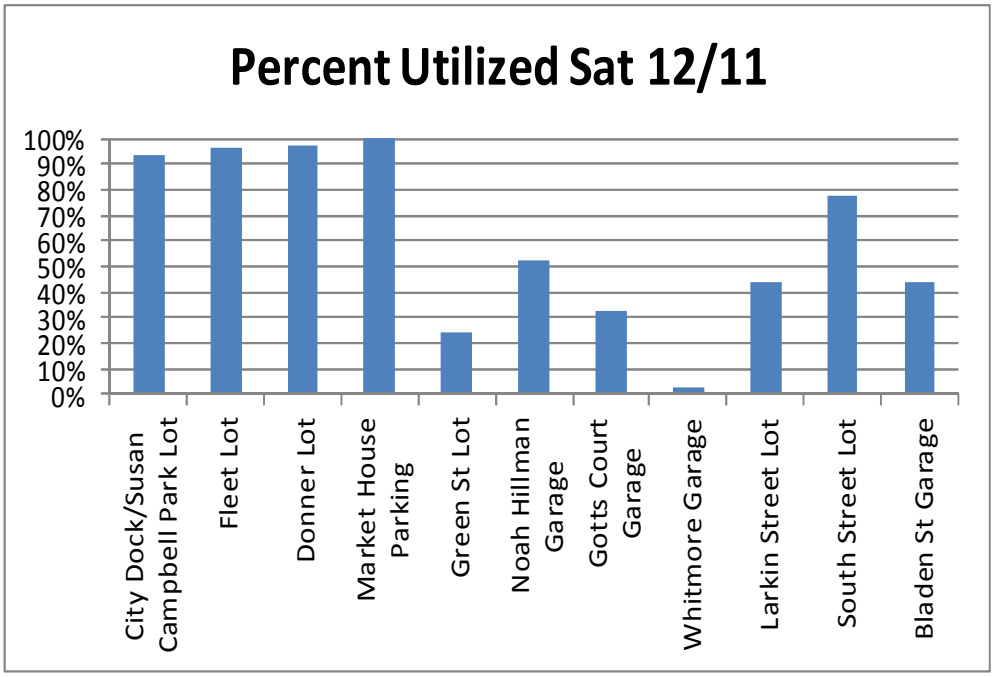


Figure 16 (Continued). Existing Peak Parking Utilization Summary



5.4 Parking Management

A review of the City's current parking management was also performed, to document existing policy for off-street, on-street, public, residential, as well as priority parking provisions. The results are summarized in **Table 2** below. The City does charge more for parking adjacent to the City Dock (e.g. Hillman) than at satellite garage locations (e.g. Knighton or Stadium lot). Satellite parking is served by free or discounted shuttles to connect to the downtown City Dock area, with service in 15 to 30 minute headways and standard daytime operating hours. However, the 'park and ride' option which is well-publicized on the City's website, is somewhat undermined by residential garage parking decals, and the park and shop program which encourage people to drive and park adjacent to the downtown City Dock area.

Taxi and valet parking locations are designated within the study area, however, there are no priority parking for carpools, car shares, or bicycles within the City-managed off-street facilities.

Lastly, the City is planning to upgrade individual coin-operated parking meters to pay-stations which will increase parking turnover and the number of available parking spaces.

Table 2. Summary of City of Annapolis Parking Policies

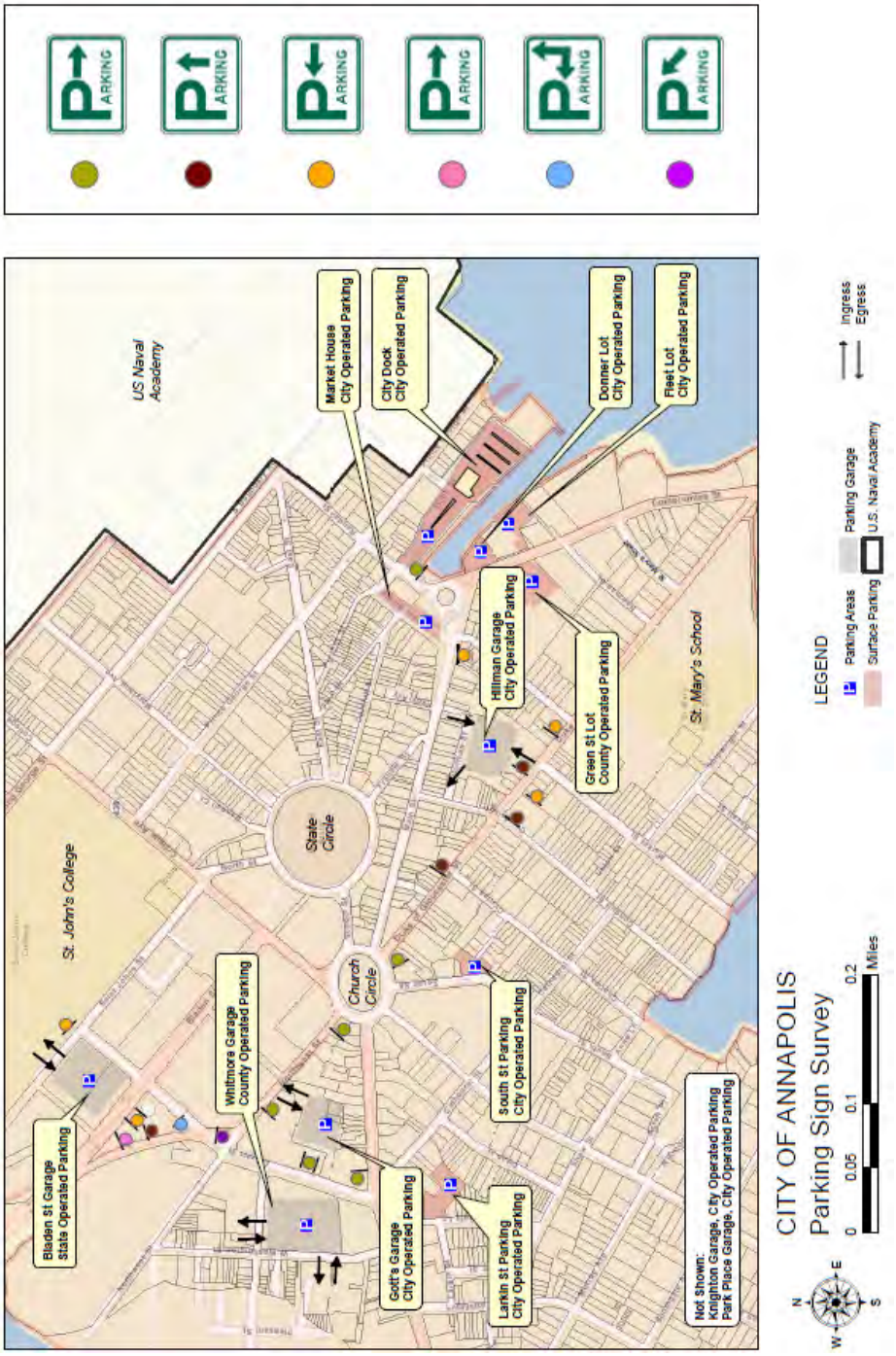
	Policy
Parking Garages	• Residents can apply for parking garage decals, which allow them 2 hours of free parking each day at any of the City's 3 garages (Hillman, Gott's, and Knighton) • Bladen Street Garage offers free evening and weekend parking • There is a Bed and Breakfast discount of 50% at the City's 3 garages. • Through the park and shop program, participating businesses offer discount parking to customers (e.g. one hour coupons). • Hourly pricing stepped 25% based on proximity – Hillman $2/ hour, Gott's $1.50/ hour, Knighton $1/ hour.
Residential Parking	• Residents can apply for on-street permits. • Parking in residential areas is limited to 2 hours without a permit. • Vehicles with handicap tags or plates are limited to 4 hours without a permit.
On-Street Curbside Metered Parking and Surface Lots	• Hours for on-street meters and metered lots are 10:00am-7:30pm Monday through Saturday, and Noon to 6:00pm on Sundays. • Vehicles with handicap tags or plates are allowed double the meter time for no additional cost. • Existing on-street metered parking is regulated by individual coin-operated meters. • Rates for on-street meters and metered lots are $1.00 per hour. • On-street meters have either a 2 hour limit or a 30 minute limit, depending on location. • The Donner Lot meters have a 2 hour limit, and Fleet Lot meters have a 10 hour limit. • South and Larkin lots require permit subscription
Taxi	• Taxi Stands are located at the foot of Main St and on West Washington St at West St
Valet	• Valet parking is available on Compromise Street near City Dock in the Donnor Lot. • Participating businesses validate valet parking for their customers.
Carpool	• There are no provisions for carpool vehicles.
Carshare	• There are no provisions for carsharing.
Bicycle	• There are no provisions for bicycle parking within the off-street parking facilities • Limited bicycle parking is provided next to Market Place and near the Harbor Masters office

5.5 Parking Facility Access and Wayfinding

Existing parking information signing, specifically wayfinding signing, as well as access points to parking garages was documented and evaluated. Existing wayfinding signing to parking garages is limited, less than two dozen directional/ trailblazing signs are posted. Although the signs are located approaching Whitmore, Bladen and Gott's Garages, they ultimately direct vehicles to the Hillman Garage via Green Street and Main Street. The signing is not systematic; it does not present multiple garage parking options clearly, or use any color or symbols to correspond to individual garage trailblazing. The signing does not provide any rate information either, or real time parking availability, thus limiting drivers decision-making prior to entering the downtown City Dock area and potentially creating additional traffic congestion as motorists search for available on-street and off-street parking.

With the exception of the access to Gott's Garage along Northwest Street, and the access to Hillman Garage along Duke of Gloucester Street, all access to structured parking garages is off of secondary and service streets, which increases the need for signing and creates additional traffic circulation patterns and pedestrian conflicts. **Figure 17** illustrates the existing Parking Wayfinding Signing and Access Points.

Figure 17. Existing Parking Wayfinding and Access Points



6.0 CIRCULATION ASSESSMENT AND FINDINGS

As a final piece of the analysis, an assessment of overall local and commuter traffic circulation patterns and major generators of pedestrian activity is summarized based on existing traffic volumes, mode shares, parking operations, and pedestrian, bicycle and transit provisions and usage. This summary documents major vehicular origins and destinations, pedestrian magnets, and gaps for each mode of travel in the study area.

6.1 Origins and Destinations

Evaluating roadway link peak hour flows reveals the roadway network in the downtown City Dock area is largely utilized for through traffic during a typical morning and evening peak by residents of Eastport and other areas of the City – without a destination in the downtown City Dock area. The peak direction of travel is northbound along Compromise and Main Street *through the downtown* in the morning as well as inbound to the satellite parking garages along Rowe Boulevard; and outbound along Rowe Boulevard from the satellite parking garages and south along Duke of Gloucester Street *through the downtown* in the afternoon. On the other hand, Saturday traffic is destined for the downtown City Dock area, with a dominant traffic flow inbound along Compromise and Duke of Gloucester Streets to the City Dock. **Figures 18a to 18c** illustrate peak hour vehicle flow bandwidths.

Figure 18a. AM Peak Hour Vehicle Flows

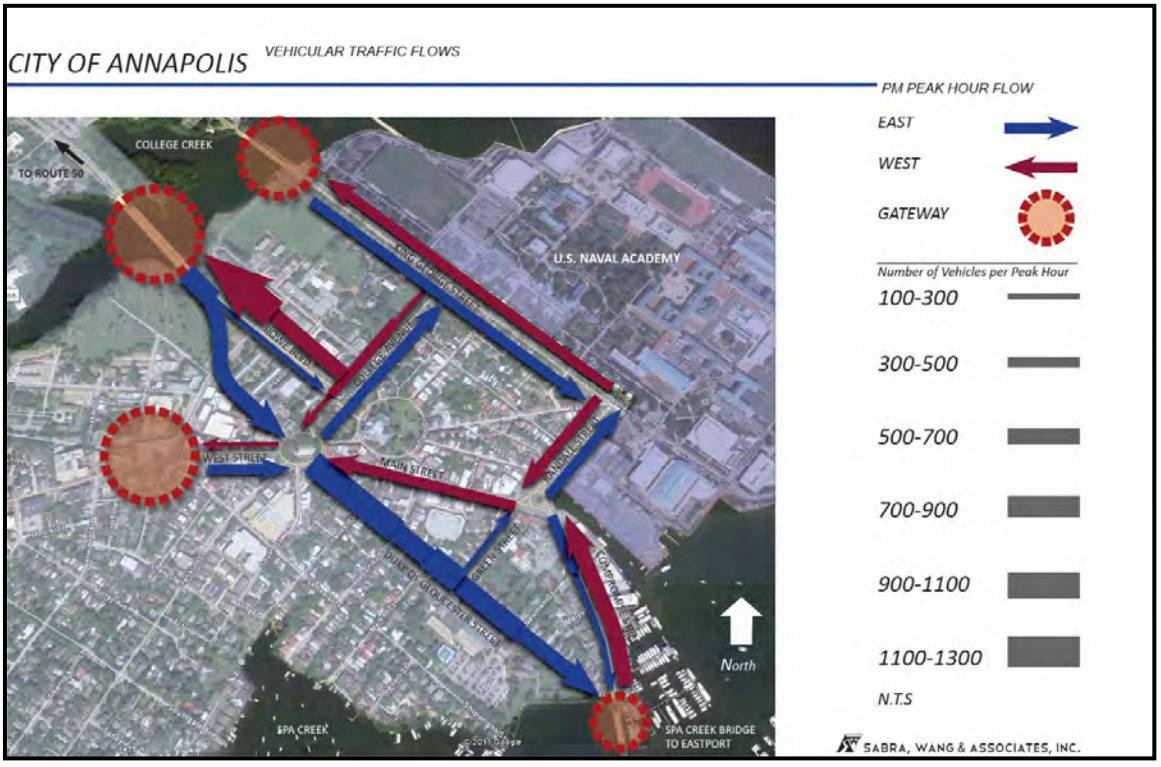


Figure 18b. PM Peak Hour Vehicle Flows

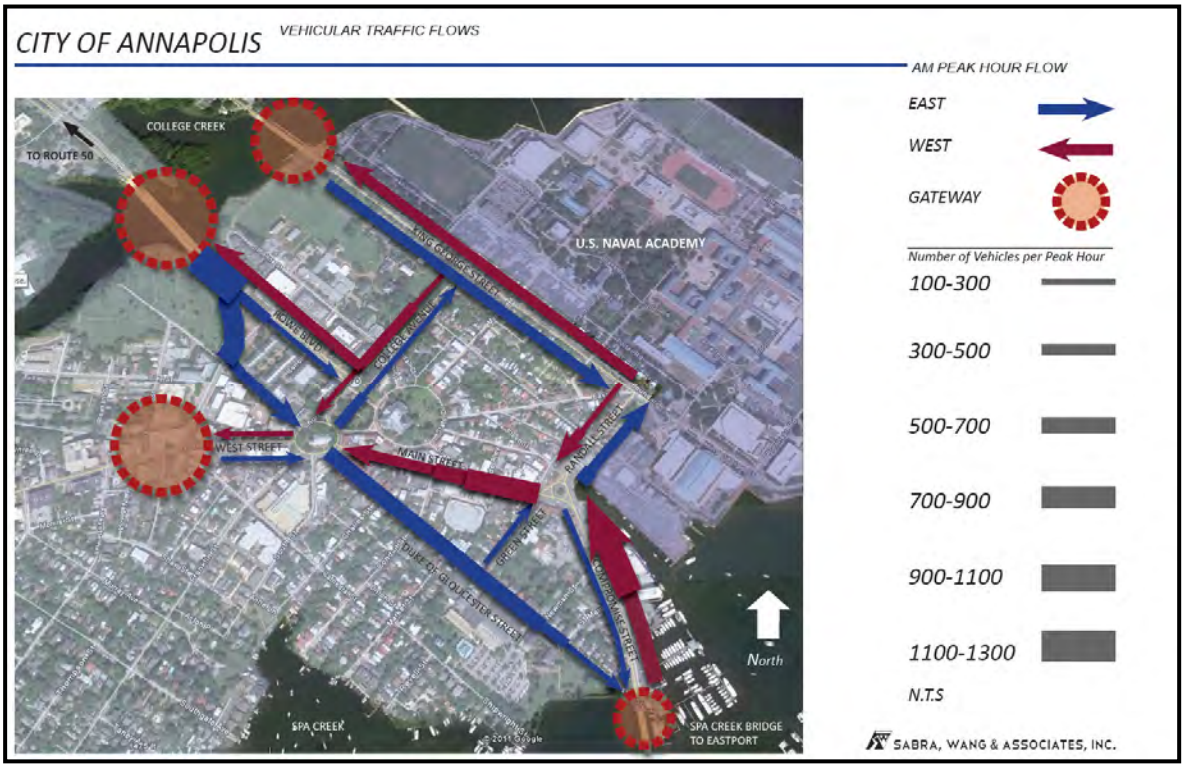
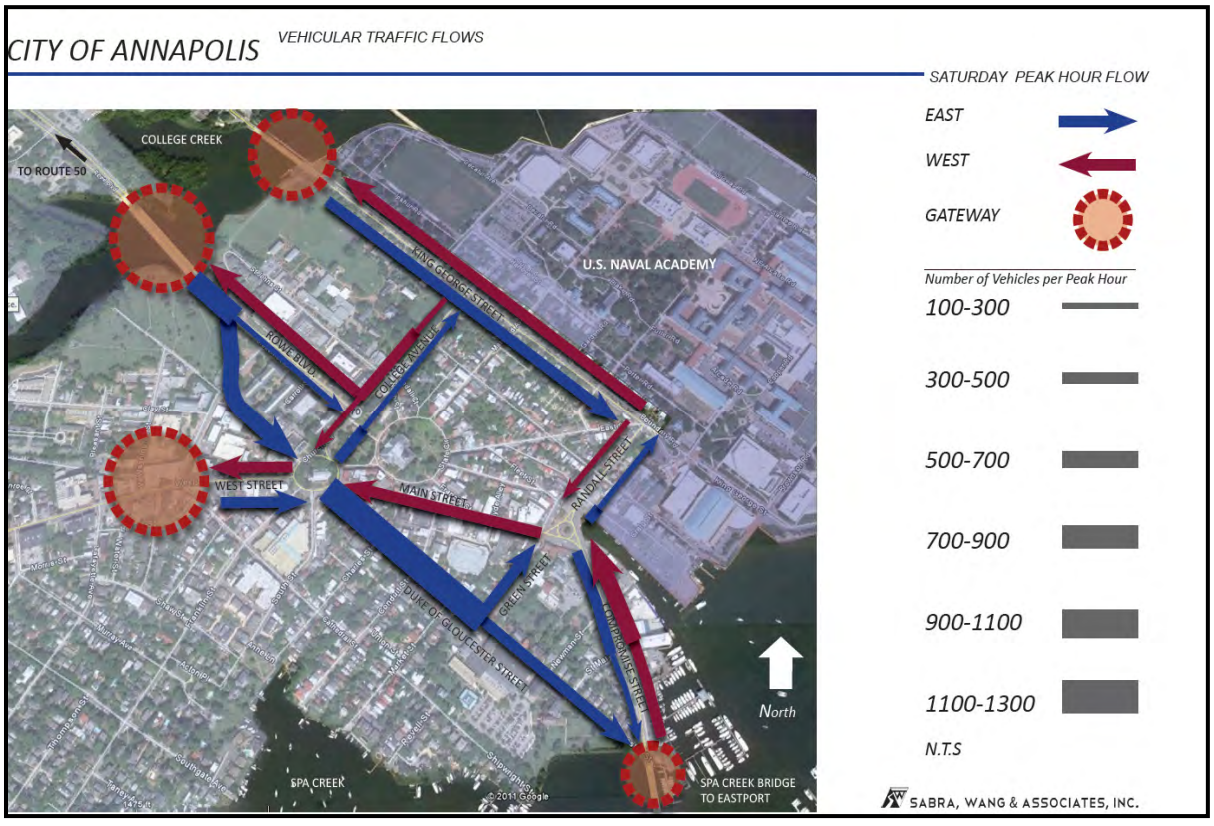


Figure 18c. Saturday Peak Hour Vehicle Flows



In addition to the vehicle origins and destinations, pedestrian traffic generators are also summarized in **Table 3** below. The largest pedestrian traffic generators are City Dock, Market Space, Main Street retail, West Street retail, and Eastport.

Table 3. Summary of Pedestrian Origins/ Destinations

	Adjacent Pedestrian Volumes				
Pedestrian Generators	AM	PM	Sat	Total	**Nearby Crosswalk**
Market Space/City Dock	35	234	746	1015	Dock at Randall NE and SW legs
City Dock/Susan Campbell Park	35	234	746	1015	Dock at Randall NE and SW legs
Main St retail	42	218	606	866	Main at Green N and S legs
West St retail	31	68	575	674	West at Calvert north leg
Marriott Hotel/Yacht Club/Spa Creek Bridge	33	97	523	653	Compromise at Newman east leg (across driveway)
Gott's Court Garage/Visitors Center	43	66	294	403	Across West St at Church Circle
USNA Gate #1	34	70	237	341	Randall at Prince George NW and SE legs
Maryland State House	15	79	160	254	State Circle at Maryland N leg
St. Mary's Catholic School	137	22	52	211	Duke at Newman and Duke at Green NW and SE legs
Newman Street Park	9	43	137	189	Compromise at Newman west leg
Charles Carroll House/Duke St churches	27	47	115	189	Duke at Conduit N and S legs
Bladen St Garage	119	38	16	173	Bladen at Calvert NE leg
St. John's College	7	55	52	114	College at Prince George NE and SW legs
Courthouse on Church Circle between West St and South St	43	66	N/A	109	West at Church Circle/ South at Church Circle

6.2 Modal Gaps

As a summary to the inventory and assessment of the existing transportation network, circulation patterns, and traffic generators, **Table 4** summarizes gaps and deficiencies noted for each mode of travel.

Table 4. Summary of Modal Gaps

Mode	Generator	Noted Gap or Deficiency	Additional Description
Bicycle	Commuting/ Recreation	Rentals/ Parking	Install racks in garages and provide rentals near garages
Bicycle	Recreation	Connect Spa Creek, Poplar, Navy Corps Trails	

Mode	Generator	Noted Gap or Deficiency	Additional Description
Bicycle	Commuting	Bay Ridge connection across Spa Creek connection to downtown	
Bicycle	Commuting	MD 450 (King George from the Severn River Bridge) connection to downtown	
Bicycle	Free Wheelin' Rental Center	Connection through Dock St. parking lot does not provide designated facilities	Access through parking lot puts bicyclists in conflict with cars. Rental location is surrounded on all sides by parking lots
Bicycle	Commuting, Main Street Retail	No marked bike facilities on Main Street	Uneven brick paving can be challenging for cyclists
Bicycle	Commuting/ Recreation	Wayfinding/ Travel Time Signing	
Pedestrian	Dock Street Retail	No connection across parking lot to retail frontage	
Pedestrian	City Dock/ Market Space	Connections across Randall, continuing through Market Space parking lot	
Pedestrian	St. Mary's School	Connections to Main Street/ City Dock via Green Street, skewed crosswalk at Duke of Gloucester with limited pedestrian queuing space	
Pedestrian	USNA	Connections along Randall Street, pedestrian signals at signalized intersection (Prince George Street)	
Pedestrian	Main Street Retail	Midblock crossings desired between marked crosswalks	
Pedestrian	Main Street Retail at Memorial Circle	Indirect access around Memorial Circle, wide vehicular lanes	
Pedestrian	City Dock and Market Space	Limited sidewalk width at Memorial Plaza space and along Market Space area	Low chain fencing provides only vertical buffer
Pedestrian	Church Circle destinations	College Ave intersection includes space pedestrians must cross	Flush median does not provide safe refuge from vehicles
Pedestrian	City Dock, Main Street retail	Limited crossings on Compromise Street	

Mode	Generator	Noted Gap or Deficiency	Additional Description
Pedestrian/ Bicycle	City Dock/Market Space, USNA, Commuting	Randall St/Dock St intersection is skewed, creating low visibility for all users and limited sidewalk space	
Transit	Commuting	Connection between MTA and City Bus	
Transit	Commuting	Connection between City Bus and Water Taxi	Relocate bus stop
Transit	All	Real-time transit info/ next bus	Enhanced traveler information may attract new riders
Transit	Day Trippers	Connections from Gott's, Whitmore, Bladen, Stadium, Knighton and Park Garages/ lots to downtown	Enhanced marking of park-and-ride option as easy, convenient, low cost way to access downtown
Vehicle	All	Real-time parking info and wayfinding signing	Enhanced traveler information may reduce congestion

7.0 IMPROVEMENT RECOMMENDATIONS

The results of the study revealed the following key modal issues:

The ***pedestrian environment*** is defined by high pedestrian volumes, complicated crossing of wide vehicle lanes and intersections, frequently desired mid-block crossings, unfamiliar tourists and distracted pedestrians, conflicts with high volumes of turning vehicles at key locations, and major pedestrian traffic generators such as Market House, City Dock, Main Street, the U.S. Naval Academy and St. Mary's School

The ***bicycle environment*** is defined by competition for limited space with high motor vehicle volumes, conflicts with turning vehicles and pedestrians, conflicts with parked cars, limited connections to regional and city-wide designated bicycle routes and trails, limited bicycle parking and limited wayfinding signing.

The ***automobile environment*** is defined by competition between automobiles and other modes for limited roadway space, unfamiliar drivers, friction of parking maneuvers and searching for available parking, tour and transit bus operations, conflicts with bicycles and high pedestrian volumes, accommodation of through/ cross-town traffic in the downtown/ City Dock area, and ad-hoc truck loading and unloading

The ***transit environment*** is defined by limited service frequencies on some routes, limited connections between satellite garages and the City Dock, limited connections

between regional and local buses, lack of real-time transit info, and limited bus stop amenities such as shelters and benches.

The ***parking environment*** is defined by ample supply, over-utilization of the downtown surface lots and garages, limited wayfinding signage, and limited real-time parking information.

In summary, missing connections and gaps were noted in the pedestrian, bicycle and transit networks such as sidewalks, bicycle lanes and parking, and bus stops, along with lack of priority in circulation patterns and traffic control treatments for non-automotive modes.

Development of ***improvement alternatives*** focused on creating streets with more balance in roadway space and intersections to prioritize vulnerable users, reducing redundant traffic patterns and circulation, and enhancing parking management, strengthening intermodal connections and providing better signing and public information about parking and travel options.

Recommendations are presented as follows:

- **Table 5** summarizes major recommendations by mode.
- Detailed descriptions and conceptual drawings are illustrated for select modal recommendations.
- Additional management tools are presented, and
- Lastly, supplemental intersection-specific minor traffic control upgrades are listed for short-term implementation.

Table 5. Summary of Transportation Improvement Recommendations by Mode

No.	Mode	Time Frame	Recommendation	Advantages/ Disadvantages
1a)	Vehicle/ Pedestrian	Long-Term	**Remove roundabout at Memorial Circle and construct a T-intersection** and install a coordinated traffic signal at the intersection of Compromise St., Main St., and Randall St. ***See pages 55-57.***	+ Provides significant amount of additional space for pedestrian amenities + More traditional intersection control with exclusive pedestrian right of way (e.g. Barnes Dance or all pedestrian phase) - Loss of parking - Loss of center island as gateway feature
1b)	Vehicle/ Pedestrian	Long-Term	**Modify geometry of Memorial Circle (shift circle east) including Randall Street road diet and** eliminate angle parking inside roundabout. ***See pages 58-59.***	+ Reduces road pavement + Improves channelization + Reduces pedestrian crossing distances, + Aligns crosswalks more closely with desire lines - Reduces parking

No.	Mode	Time Frame	Recommendation	Advantages/ Disadvantages
1c)	Pedestrian	Short-Term	**Move yield line** to Memorial Circle further east on Compromise Street and add appropriate signing.	+ Reduces 'multiple threat' conflict for drivers from both directions of Compromise
2)	Vehicle	Short-Term	**Convert Main Street to two-way** between Randall and Conduit, along with necessary wayfinding signing changes.	+ Direct route to City Dock may reduce traffic on Green and Duke of Gloucester - Would eliminate some curb parking - May increase conflicts with pedestrians
3)	Vehicle/ Pedestrian	Short-Term	**Reverse flow on Market Space** to one-way away from Main Street and eliminate left turn lane on **Randall Street (road diet)** along with necessary wayfinding signing changes.	+ Reduces conflicts and congestion at Main St + Improves lane alignment on Randall St + Reduces pedestrian crossing distance on Randall St + Provides wider sidewalks - Less direct access
4)	Vehicle/ Pedestrian	Short-Term	Install **new coordinated traffic signal** at Randall St/ Dock St/ Market Space. Coordinate existing signal at Randall Street and Prince George's Street with this new signal.	+ Improved pedestrian access + Reduces conflicts + Could implement Barnes Dance - May divert traffic from Prince George St
5)	Vehicle/ Pedestrian	Short-Term	**Traffic signal timing** – consider increasing cycle length to 80 to 90 seconds during weekend peak hours.	+ Allows time for Barnes Dance - Increase in vehicle delay
6)	Vehicle/ Pedestrian	Short-Term	Implement a **Market Space road diet** by reducing travel lane width and/ or converting angled parking to parallel. Consider part-time or full-time conversion to pedestrian mall. ***See pages 60-61.***	+ Reduces pedestrian crossing distance on Randall St + Provides wider sidewalks - Will reduce number of parking spaces
7)	Vehicle/ Pedestrian	Short-Term	**Implement No Right Turn on Red at** West and Church, Main and Church.	+ Reduces conflicts - Increases vehicle delay and queue
8)	Vehicle	Short-Term	**Restrict left turn** from Duke of Gloucester to Compromise due to limited sight distance.	+ Increases safety - Restricts access - May increase traffic on Newman, St. Mary's
9)	Parking	Short-Term	Implement a **trial weekend and weekday closure** of the City Dock, Donner, Fleet and Green parking lots. Monitor usage of other garages, and then develop wayfinding parking signing plan.	+ May demonstrate some parking spaces are not needed - May result in business and visitor complaints
10)	Parking	Short-Term	**Implement performance pricing** for metered spaces and garages near City Dock (Hillman, Donner, Fleet, Green, City Dock, Market Space, Main Street).	+ Higher rates during peak demand may reduce auto trips - Policy be met with opposition
11)	Parking	Long-Term	**Develop parking information system** with electronic messaging, real-time info along West St and Rowe Blvd**,** iPhone apps, etc.	+ Increases utilization of satellite garages + Reduces recirculation congestion near City Dock - Cost
12)	Parking	Long-Term	**Replace existing parking meters with automated pay stations.**	+ Will increase utilization and parking density. + Improves enforcement and fare collection efficiency.
13)	Parking	Short-Term	**Implement designated carpool and carshare spaces** in Hillman Garage.	+ Will encourage use of carpools and carshares - Loss of general parking spaces

No.	Mode	Time Frame	Recommendation	Advantages/ Disadvantages
14)	Water Taxi	Long-Term	**Create a designated stop at Jonas Park and create a park and ride location for alternative access from US 50.**	+ Encourages satellite parking + Reduces auto congestion - May be opposed by park users and adjacent land owners
15)	Pedestrian	Short-Term	**Implement targeted ADA upgrades** with curb ramp improvements, detectable surfaces, accessible pedestrian signals at high-volume pedestrian intersections.	+ Improves accessibility - Cost
16)	Pedestrian	Short-Term	**Install LED rapid flash beacon** for crosswalk at Duke/ Green Street.	+ Improves visibility - Does not provide exclusive pedestrian right of way
17)	Pedestrian	Short-Term	**Construct pedestrian refuge island at St. Mary's St and Compromise St.** ***See pages 62-63.***	+ Reduces pedestrians exposure - May increase vehicle delay for left-turn
18)	Pedestrian	Short-Term	**Implement crossing and sidewalk improvements in City Dock surface lot and along retail frontage.** ***See pages 64-65.***	+ Will make pedestrians more visible to vehicles - Loss of parking spaces
19)	Bicycle	Short-Term	**Provide new bicycle parking** along Main St and in City Dock lot by eliminating one or two vehicle parking spaces or use of temporary/ portable bicycle corrals that can be moved around or only installed on weekends.	+ Improves bicycle access - Loss of vehicle parking
20)	Bicycle	Short-Term	**Provide bicycle rentals and shares** at Memorial Circle and two satellite garages.	+ Will encourage 'park and bike'
21)	Bicycle	Long-Term	**Develop signed/ physical trail connections to Spa Trail-Poplar Trail-Navy Memorial Trail.**	+ Will increase bicycle access to City Dock - May require taking space from parking or travel lanes
22)	Bicycle	Short-Term	**Improve signage for Colonial Annapolis Maritime Trail.**	+ Will improve wayfinding as well as advertise the trail throughout the Dock area
23)	Bicycle	Short-Term	**Improve bicycle access from Eastport** into City Dock (lanes, signs, shared lane and colored markings).	+ Will increase bicycle access to City Dock - May require taking space from parking or travel lanes
24)	Bicycle	Short-Term	**Improve bicycle access from Weems/College Creek/ Severn River** into City Dock (lanes, signs, shared lane and colored markings).	+ Will increase bicycle access to City Dock - May require taking space from parking or travel lanes
25)	Bicycle	Long-Term	**Construct 2-way cycle track on Main Street.** ***See pages 66-67.***	+ Will increase bicycle access to City Dock - Would eliminate curb parking on one side of Main Street
26)	Transit	Short-Term	**Consolidate bus stops/ shelters in Church Circle to improve transfers.**	+ Will enhance and simplify transfers - May require minor rerouting
27)	Transit	Short-Term	**Construct new bus stop/ shelter at City Dock.**	+ Will enhance comfort and convenience for transit users, strengthen intermodal connections - May require minor rerouting

7.1 Roadway Improvements

This section presents and discusses detailed aspects of select recommendations from **Table 5.** These specific recommendations were selected based on their relative potential to positively impact mobility options and traffic circulation in the study area. These recommendations were also selected based on the results of the Vehicle X Pedestrian volume cross-product analysis shown on p. 32 and the field observations detailed on pp. 34-36 of this report. Making improvements to areas with more conflict points will greatly enhance the safety of the downtown experience for many users.

Recommendation 1a – Remove Roundabout at Memorial Circle and Construct a T-Intersection

One option to improve the existing traffic circle at the Main Street/Compromise Street/Randall Street intersection is to replace the circle with a traditional intersection. Illustrated in **Figures 19a and 19b**, this recommendation would result in the loss of approximately 22 to 32 parking spaces. The intersection would be controlled by a coordinated traffic signal, with full pedestrian provisions including marked crosswalks, curb ramps, pushbuttons, and countdown pedestrian signal indications. The intersection would provide exclusive turn lanes for all approaches. Even with the turn lane, significant roadway narrowing would be possible creating additional sidewalk or plaza space for pedestrians. One variation of this alternative would include aligning Compromise Street and Main Street at the 'through' street and bring Randall Street up to a 'T' as the minor street leg, while the other would align Randall Street and Main Street as the 'through' street and bring Compromise Street up to a 'T' as the minor street leg. Under the former configuration, additional sidewalk and plaza space would be located adjacent to the harbor, and the latter would provide sidewalk and plaza space adjacent to the storefronts. This space could also be used as a service or loading area.

Figure 19a. Option 1, Recommendation 1a – Remove Roundabout at Memorial Circle and Construct a T-Intersection

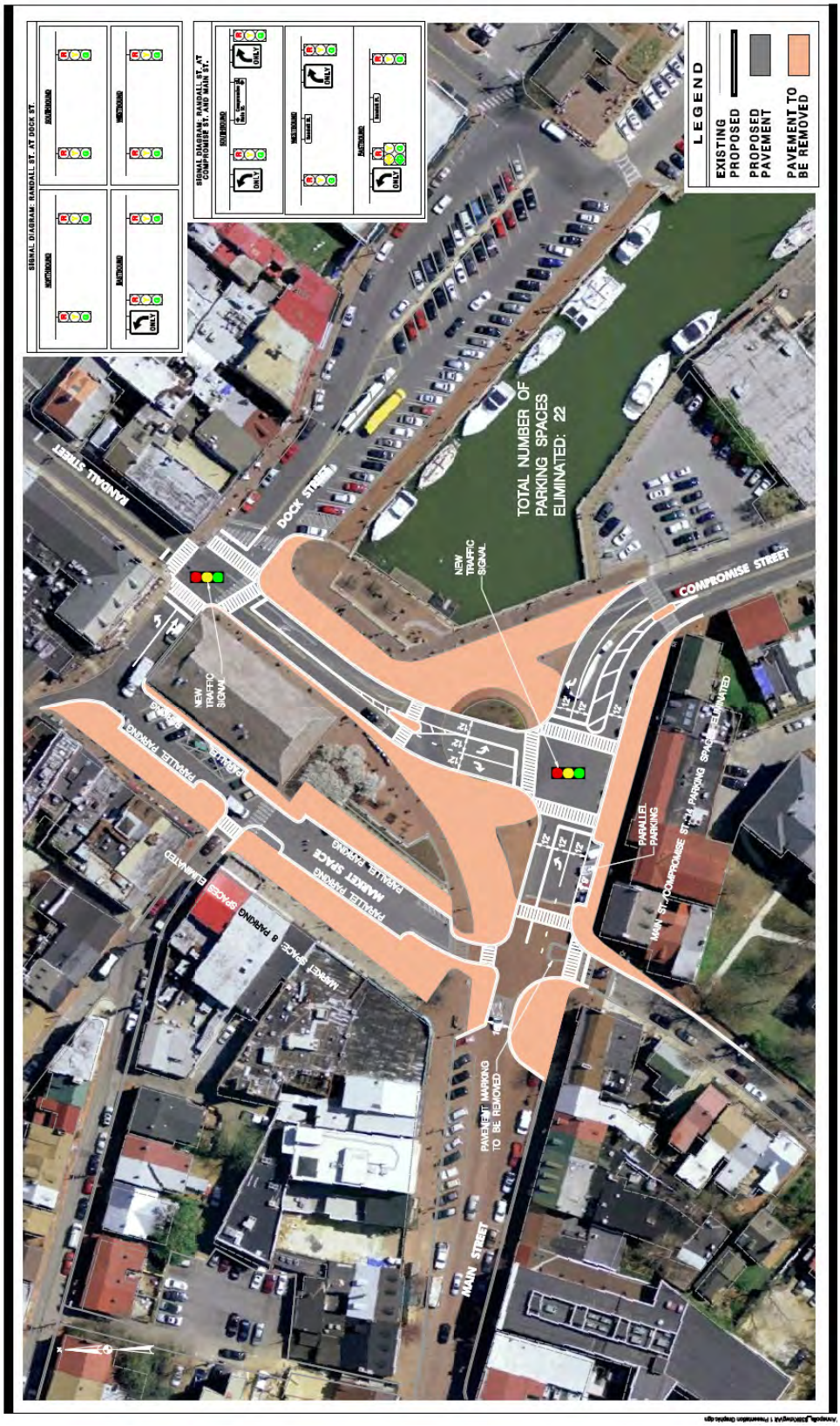
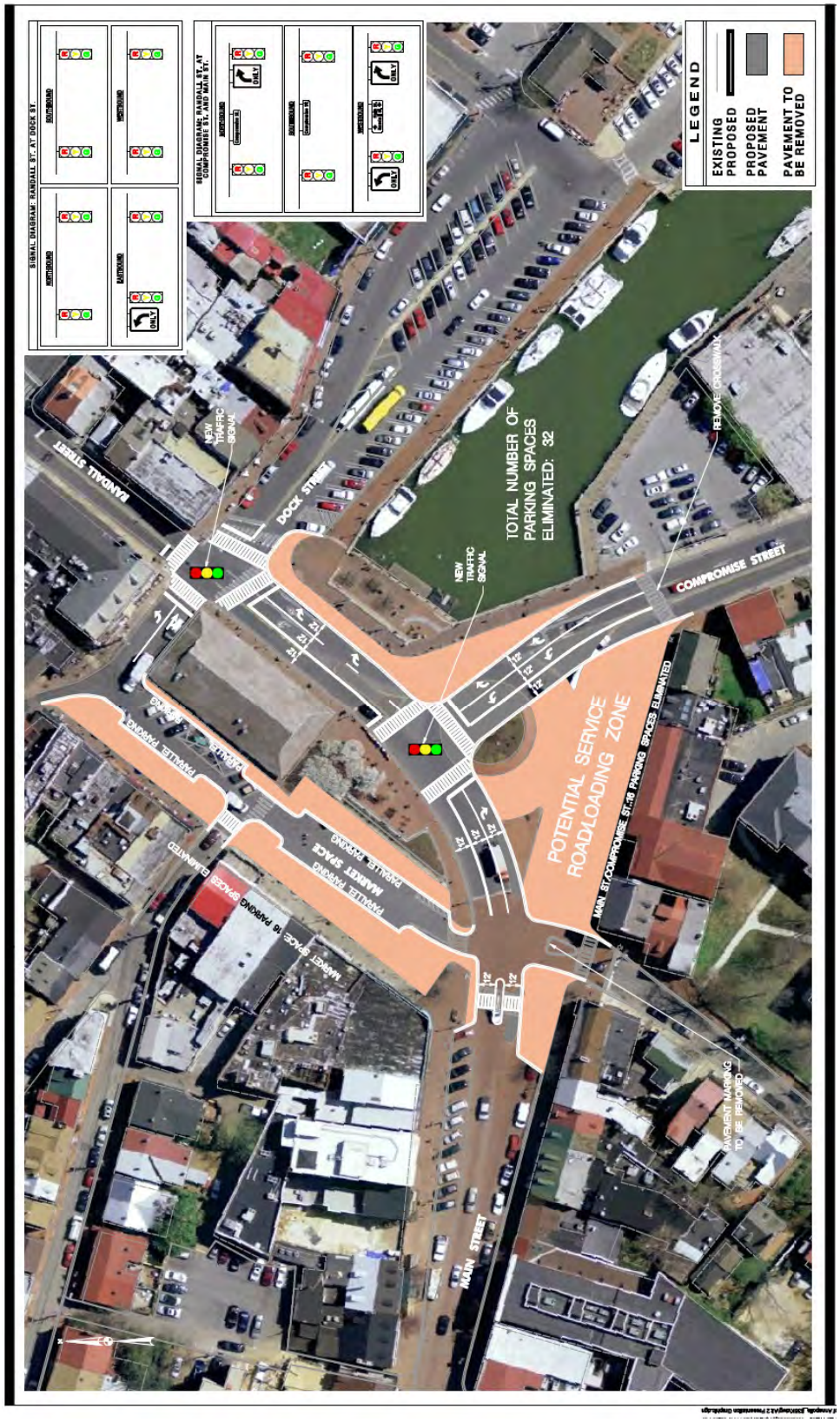


Figure 19b. Option 2, Recommendation 1a – Remove Roundabout at Memorial Circle and Construct a T-Intersection

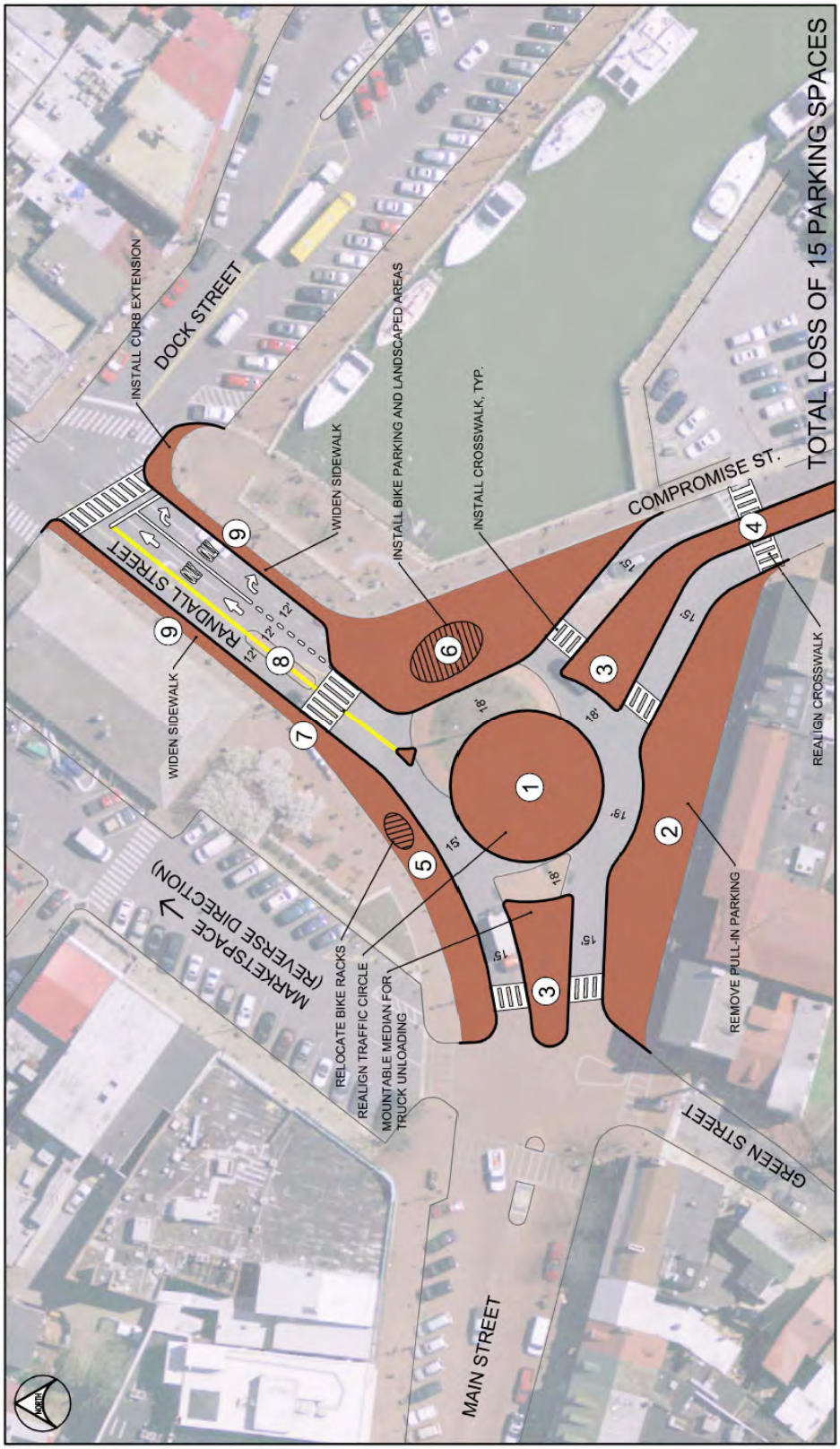


Recommendation 1b – Modify Geometry of Memorial Circle

One option to improve the existing traffic circle at the Main Street/Compromise Street/Randall Street intersection is to realign the island and adjust the existing curb lines to provide additional pedestrian space along the harbor area and commercial zones surrounding the traffic circle. Illustrated in **Figure 20**, this recommendation would result in the loss of approximately 15 parking spaces from the parking area along the south side of the circle.

It is recommended that the traffic circle be shifted approximately 50-75 feet southwest of its current position, and the travel lane be reduced to 18 feet to slow vehicular traffic and reduce conflicts that may result from the existing wide lane (1). The existing pull-in parking should be reclaimed for the pedestrian environment and improved through amenities such as benches and planters. The removal of parking creates additional pedestrian space, as well as reduces vehicular conflicts be removing the parking access lane that motorists in the traffic circle must currently merge into to access southbound Compromise Street (2). The existing traffic islands should be widened to reclaim under-utilized roadway space and high-visibility crosswalks should be installed along primary pedestrian desire lines (3). The existing crosswalk across Compromise Street directly south of the intersection should be realigned to reduce the crossing distance for pedestrians (4). The narrowing of the traffic circle travel lane will also allow widening the pedestrian plaza space between the traffic circle and Market Place (5). It is recommended the resulting space be reconfigured to improve the pedestrian experience and provide more accessible bike parking. The realignment will provide additional pedestrian space along the harbor that will improve pedestrian circulation, as well as the experience of all roadway users. It is recommended that bike parking be added to this area, as well as amenities such as benches and planters (6). A high-visibility crosswalk should be installed directly south of the median on Randall Street north of the traffic circle, as this is a major pedestrian desire line (7). The existing median should be removed from the roadway (8). It is also recommended a road diet be implemented on Randall Street, creating additional pedestrian space along both sides of the street (9).

Figure 20. Recommendation 1b – Modify Geometry of Memorial Circle



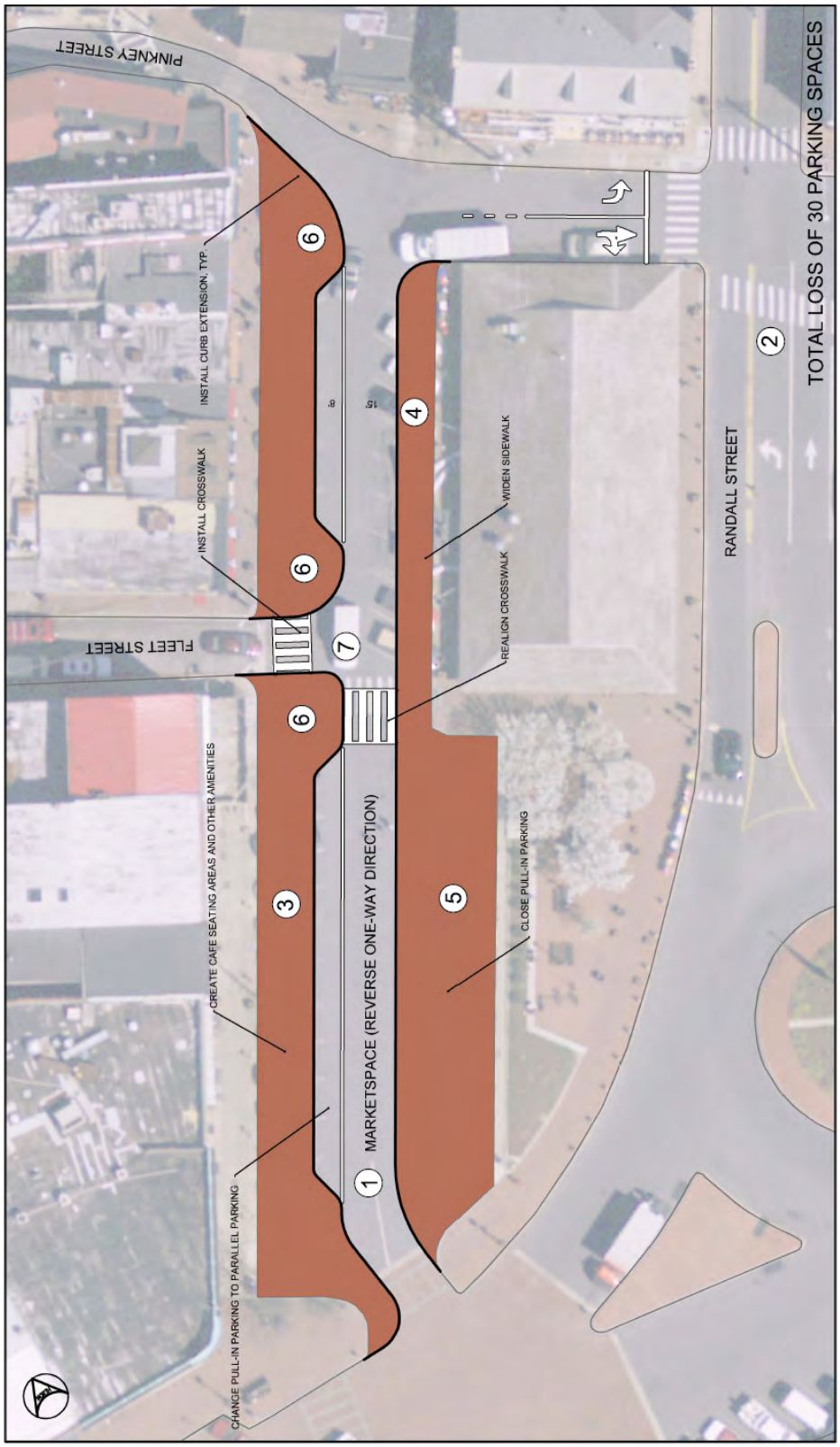
(1) Shift the traffic circle 50-75 feet southwest of its current position, and reduce the travel lane to 18 feet. (2) Reclaim the existing pull-in parking for the pedestrian environment. (3) Widen existing traffic islands and install high-visibility crosswalks along primary pedestrian desire lines. (4) Realign the crosswalk across Compromise Street directly south of the intersection to reduce the crossing distance for pedestrians. (5) Widen the pedestrian plaza space between the traffic circle and Market Place. (6) Reconfigure with benches and planters to improve the pedestrian experience and provide more accessible bike parking. (7) Install a high-visibility crosswalk directly south of the median on Randall Street north of the traffic circle, as this is a major pedestrian desire line. (8) Remove the existing median. (9) Implement a road diet on Randall Street to create additional pedestrian space.

Recommendation 6 – Market Space Road Diet

A road diet is recommended for Market Space to improve the quality of the streetscape and pedestrian experience, by reclaiming roadway space to create additional walking and gathering spaces. Illustrated in **Figure 21**, this improvement would result in the loss of approximately 30 parking spaces from the Market Space lot.

It is also recommended that the direction of Market Space be reversed to flow eastward (1), in order to improve pedestrian safety at the Market Space/Main Street/Green Street intersection by reducing the number of vehicles entering the intersection. The reversal of traffic direction will also improve movements at the Randall Street/Dock Street intersection by removing the need for a left-turn lane from northbound Randall Street into Market Space (2), allowing for a road diet on Randall Street that could create additional pedestrian streetscape space, as well as reduce the crossing distance for pedestrians crossing Randall Street from the harbor area. It is recommended that the vehicular travel lane on Market Space be narrowed to 15 feet to slow vehicular traffic but allow for commercial truck access, and the sidewalk along the west side of Market House be widened to improve pedestrian circulation and experience (3), with streetscape features such as benches and planters. The pull-in parking on the east side of Market Space should be completely closed and converted to sidewalk space (4). It is recommended that the plaza space directly east of the existing pull-in parking be reconfigured to incorporate the newly created sidewalk space and emphasize the connection between Market Space and the harbor area (5). In addition, the pull-in parking on the west side of Market Space should be converted to parallel parking, reducing the required spatial needs for vehicular parking and allowing for the creation of additional pedestrian spaces. The reconfiguration could allow for café seating and amenities such as benches and planters to be added. Curb extensions at Fleet Street and Pinkney Street will reduce pedestrian crossing distances, as well as slow turning vehicular traffic, further improving the pedestrian experience (6). The existing high visibility crosswalk across Market Space at Fleet Street should be widened to 15 feet and realigned with the proposed curb extension (7). A high visibility crosswalk should also be striped across Fleet Street.

Figure 21. Recommendation 6 – Market Space Road Diet



(1) Reverse the direction of Market Space flow. (2) Remove the left-turn lane from northbound Randall Street into Market Space. (3) Narrow the vehicular travel lane on Market Space to 15 feet and widen the sidewalk along the west side of Market House. (4) Remove the pull-in parking on the east side of Market Space and convert to sidewalk space. (5) Reconfigured to the newly created sidewalk space to emphasize the connection between Market Space and the harbor area. (6) Add curb extensions at Fleet Street and Pinkney Street. (7) Widen the existing high visibility crosswalk across Market Space at Fleet Street to 15 feet, realign with the proposed curb extension and install a high visibility crosswalk across Fleet Street.

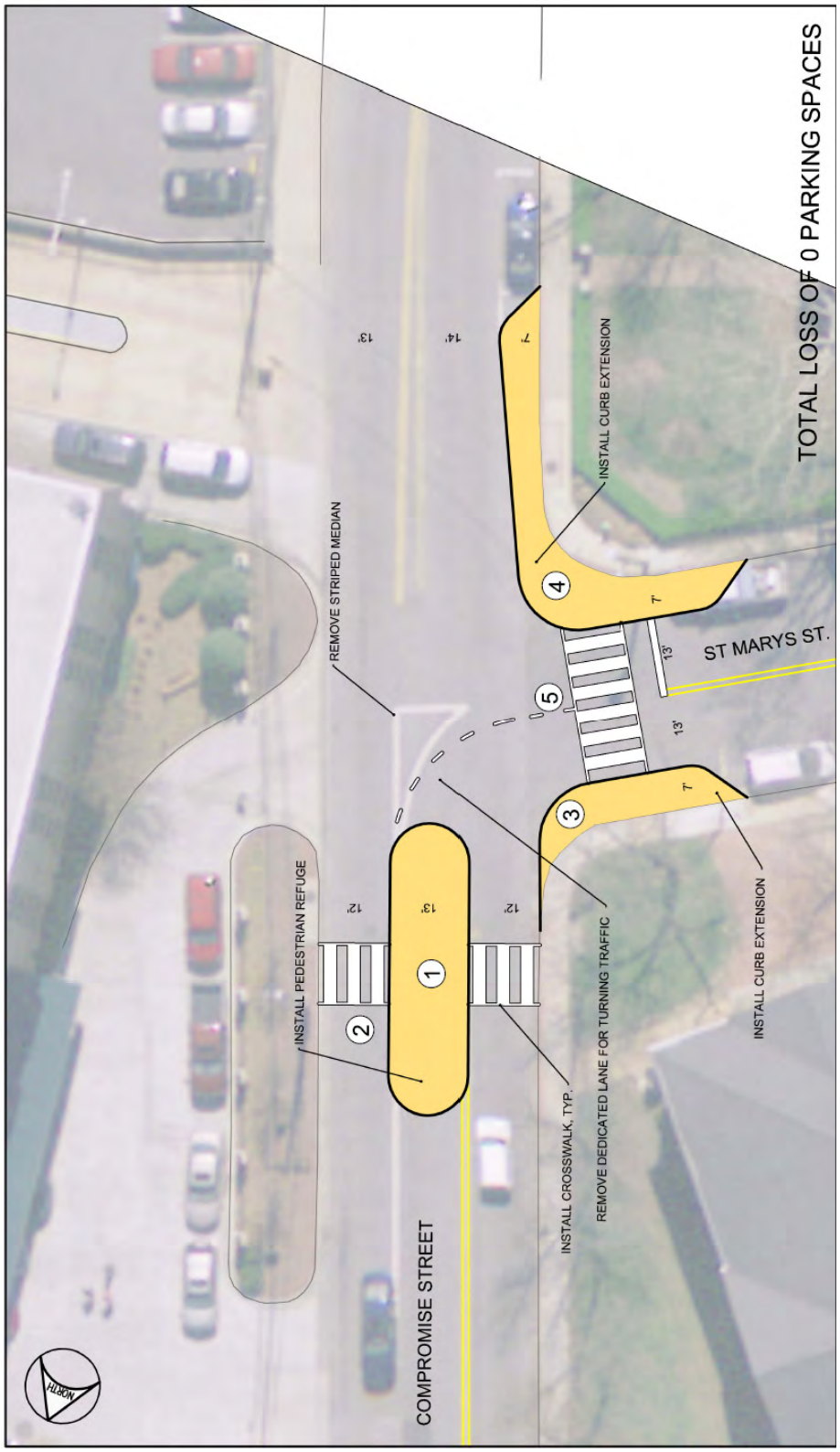
7.2 Pedestrian

Recommendation 17 – Construct Pedestrian Refuge Island at St. Mary's Street and Compromise Street

Pedestrian crossing improvements are recommended for the St. Mary's Street/Compromise Street intersection to provide a designated crossing across Compromise Street and enhanced connections to the water, and waterfront businesses. The proposed median refuge island would operationally impact left-turning traffic from St. Mary's, eliminating the current lane addition and requiring vehicles egressing St. Mary's Street to wait for gaps in both directions of Compromise Street. No parking would be impacted by this recommendation. This concept is illustrated in **Figure 22**.

It is recommended a pedestrian refuge, approximately 13 feet wide, be installed on Compromise Street, utilizing a portion of the dedicated turn lane from St. Mary's Street onto northbound Compromise Street (1). This allows for two 12 feet lanes of traffic on Compromise Street. High visibility crosswalks (2) should be installed with the pedestrian refuge, as well as pedestrian crossing warning signs. It is also recommended that curb extensions be installed across St. Mary's Street (3), to reduce crossing distances for pedestrians traveling along Compromise Street and improve visibility for all modes of traffic. The curb extension on the southwest corner of the intersection should extend into the un-utilized roadway space located adjacent to the parallel parking on Compromise Street (4). The curb extensions will result in a travel lane width of 13 feet for each direction on St. Mary's Street. A high-visibility crosswalk should be installed across St. Mary's Street, and a dashed lane stripe should be added to guide traffic from St. Mary's Street onto northbound Compromise Street (5).

Figure 22. Recommendation 17 – Construct Pedestrian Refuge Island at St. Mary's Street and Compromise Street



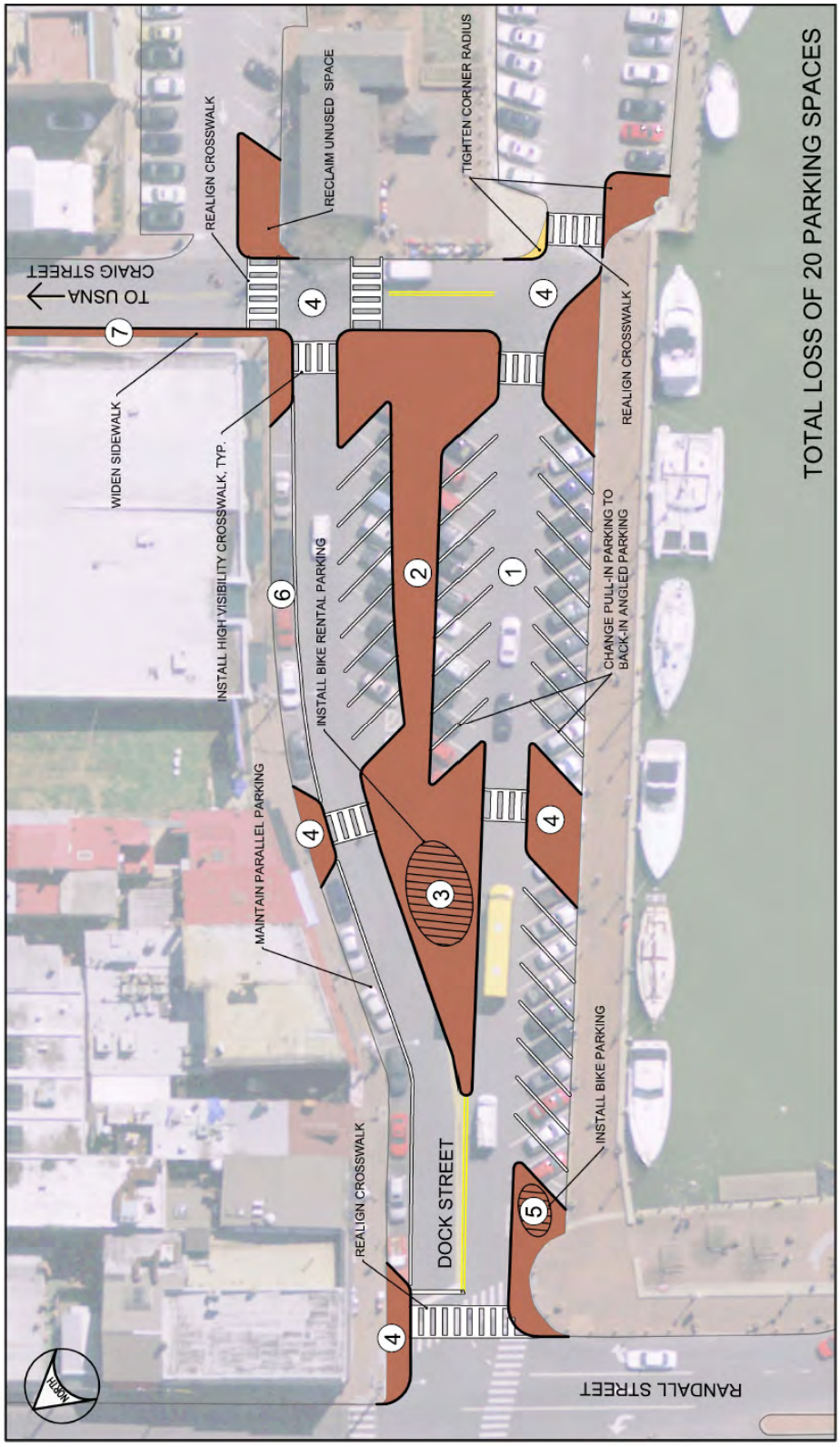
(1) Install a pedestrian refuge approximately 13 feet wide on Compromise Street, utilizing a portion of the dedicated turn lane from St. Mary's Street onto northbound Compromise Street. (2) Install high visibility crosswalks with the pedestrian refuge, as well as pedestrian crossing warning signs. (3)Install curb extensions across St. Mary's Street. (4) Extend the curb extension on the southwest corner of the intersection into the un-utilized roadway space adjacent to the parallel parking on Compromise Street. (5) Install a high-visibility crosswalk across St. Mary's Street and add a dashed lane stripe to guide traffic from St. Mary's Street onto northbound Compromise Street.

Recommendation 18 – Implement Crossing and Sidewalk Improvements in City Dock Surface Lot and Along Retail Frontage

A road diet is recommended for the Dock Street parking lot to improve the pedestrian connections between the water and Dock Street establishments, as well as improve the quality of the pedestrian experience. The recommendations will also improve safety and circulation for bicyclists by calming traffic. Illustrated in **Figure 23**, this improvement would result in the loss of approximately 20 parking spaces from the Dock Street parking lot.

The road diet will narrow the travel lane to 15 feet and modify pull-in parking to be reverse angle back-in parking (1). Reverse angle back-in parking requires less roadway space than pull-in or perpendicular parking, and reduces the risk of motorists backing into a bicyclist while exiting a parking space. The new parking orientation will allow the median between parking stalls to be widened (2) to provide a pathway for pedestrians crossing the parking lot, as well as additional space for loading/unloading parked vehicles. The widened median will also provide space for amenities such as benches or planters, as well as bike parking (3). It is also recommended that high-visibility crosswalks with curb extensions and curb radius reductions be installed at key crossing locations (4) to reduce crossing distances for pedestrians and improve visibility for both motorists and pedestrians. The reduction of curb radii can also slow turning vehicular traffic. The re-orientation of the parking stalls and the installation of a curb extension on the southeast corner of the Dock Street/Randall Street intersection provides space for a secondary bike parking area (5). Parallel parking on the north side of the parking lot should be maintained and striped (6). The sidewalk on the west side of Craig Street should be widened to improve pedestrian connections to the nearby United States Naval Academy (7).

Figure 23. Recommendation 18 – Implement Crossing and Sidewalk Improvements in City Dock Surface Lot and Along Retail Frontage



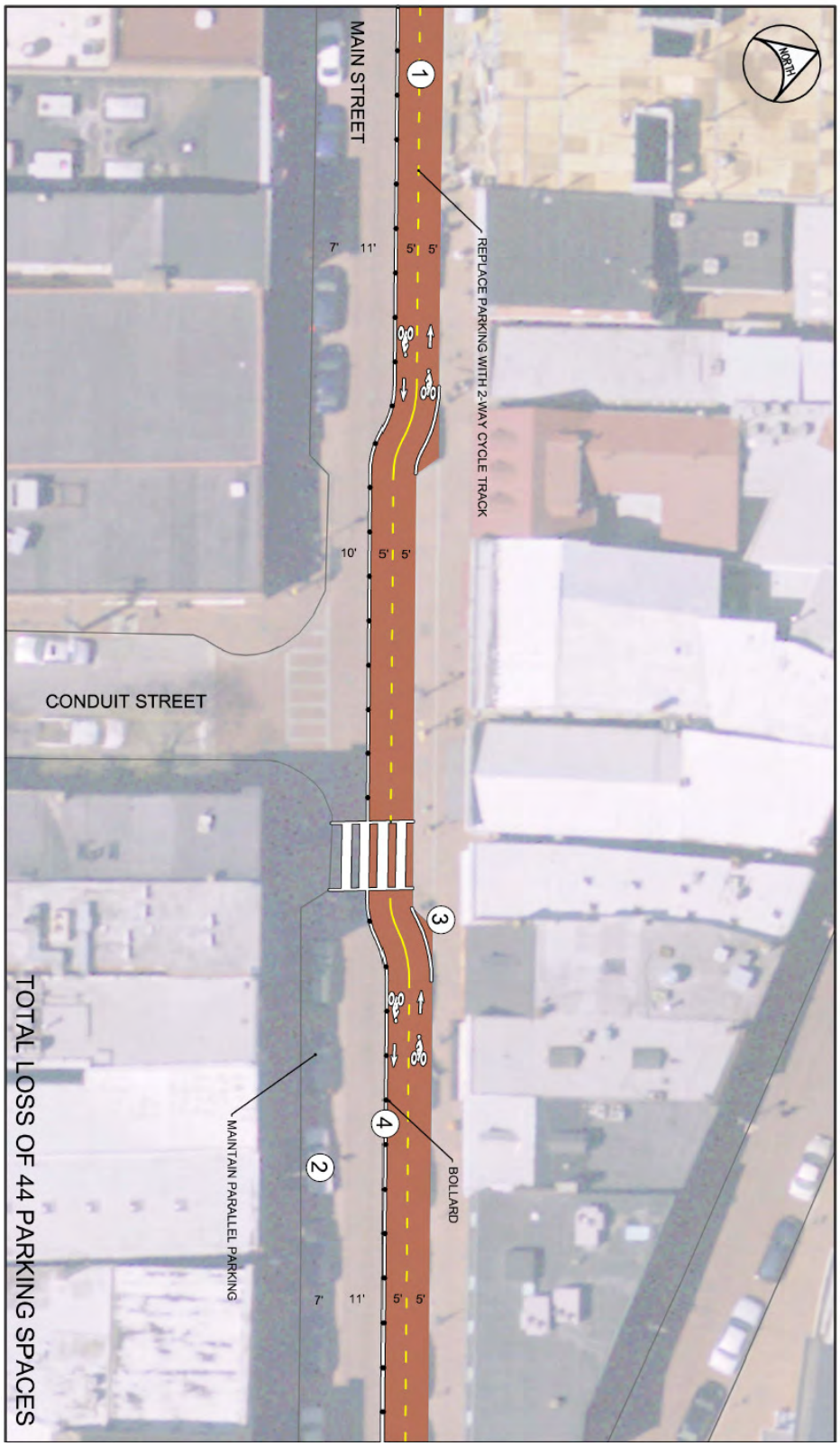
(1) Narrow the travel lane to 15 feet and modify pull-in parking to be reverse angle back-in parking. (2) Widen the median between parking stalls to provide a pathway for pedestrians and room for loading and unloading vehicles. (3) Install amenities such as benches, planters, and bike parking. (4) Install high-visibility crosswalks with curb extensions and curb radius reductions at key crossing locations. (5) Provide a secondary bike parking area. (6) Maintain and Stripe parallel parking on the north side of the parking lot. (7) Widen the sidewalk on the west side of Craig Street.

7.3 Bicycle

Recommendation 25 – Construct 2-Way Cycle Track on Main Street
Illustrated in **Figure 24**, this recommendation would result in the loss of approximately 44 parking spaces from Main Street. A photo of a similar cycle track in Washington, D.C., and a photo of bicycle wayfinding signing with travel times, is shown below.

It is recommended that dedicated bicyclist space be considered for the Main Street corridor between Church Circle and the City Dock as a two-way cycle track on the north side of the street (1). The cycle track would replace existing parallel parking and reduce the Main Street travel lane to 11 feet; the parallel parking on the south side of Main Street would remain (2). At intersection locations with curb extensions or other physical restraints, the vehicular travel lane will be reduced to 10 feet wide and the cycle track should be designed to transition around curb extensions (3). The recommended cycle track will have a 5 foot travel lane in each direction, separated from the vehicular travel lane by bollards and markings (4). A dashed yellow line should separate the direction of bicycle traffic on the cycle track. All existing crosswalks should be maintained. At the Main Street/Green Street/Market Place intersection, the cycle track should transition eastbound bicyclists to the south side of the road by way of the existing crosswalk across Main Street, with appropriate signage and markings.

Figure 24. Recommendation 25 – Construct 2-Way Cycle Track on Main Street



(1) Provide a two-way cycle track on the north side of Main Street between Church Circle and the City Dock by removing existing parallel parking on the north side of Main Street and reducing the travel lane to 11 feet. (2) Maintain existing parallel parking on the south side of Main Street. (3) At intersection locations with curb extensions or other physical restraints, reduce the vehicular travel lane to 10 feet wide and transition the cycle track around curb extensions. (4) Provide a 5 foot bicycle travel lane in each direction, separated from the vehicular travel lane by bollards and markings. Separate the direction of bicycle traffic on the cycle track with a dashed yellow line.

7.4 Transit

An example of NextBus signing is shown to the right from a similar small urban transit system.

7.5 Parking

The balancing of parking demand and supply will have an important influence on the long-term success and viability of the downtown City Dock area as a place for pedestrians, bicycles and transit. Providing too much and too inexpensive parking may discourage people from using other modes of travel and limiting the potential for a more balanced mode share. However, providing too little or too costly parking may deter potential residents, employers and customers from living, working and patronizing the downtown City Dock area.

One way to encourage more efficient utilization of parking supply for off-street parking facilities is a 'Park and Ride'/ 'Park Once' system, which uses a real-time parking information system, as shown to the right.

7.6 Demand and System Management

Although the private automobile will continue to play a substantial role in the downtown City Dock transportation system, there is significant potential to leverage the extensive transit system, walkability and bikeability, and mixed land uses to reduce overall demand for automobile travel. Demand can be managed different ways using two non-capital management tools: Transportation System Management and Transportation Demand Management.

Transportation System Management (TSM) options generally consider non-capital intensive measures such as lane configuration changes, parking restrictions, left-turn restrictions, new signalized intersections, roadway extensions to complete a grid network, and changing roadways within the grid system from two-way to one-way directional pairs.

Transportation Demand Management (TDM) derives from individual decisions driven by numerous factors (e.g., trip purpose, available modes, distance, costs, etc.). By shifting these factors to favor non-auto travel for some travelers, programmatic TDM strategies have the potential to have a large positive impact. Based on the predicted increases in travel demand, the cost of potential roadway improvements and the need for more sustainable transportation systems, there is a strong need to manage future trips into the downtown City Dock area. Managed trips are defined as:

- trips shifted to another mode,
- trips shifted to another time (outside of peak hour),
- trips shifted to another route

The City has an existing TDM policy under the 2009 Annapolis Comprehensive Plan (Policy 10 in Chapter 4 – Transportation).

There are some organizations that work to ensure that appropriate TDM programs are already in place within the greater Annapolis area – for example, the Annapolis Regional Transportation Management Association (ARTMA) *http://www.artma.org*. ARTMA is a non-profit, member-controlled organization, which provides transportation services and information in a given area. Transportation Management Associations (TMAs) such as ARTMA are generally created through a public-private partnership where area residents and businesses work with local government to provide an institutional framework for the programs. TMAs are typically more efficient than government-controlled programs because they are administered directly by the member organizations. By pooling resources within the service area, TMAs also allow smaller businesses to offer commute benefits or programs typically associated with larger companies. The strongest TMAs:

- support a variety of transportation services, travel options and incentives, including planning efforts to create more pedestrian- and transit-friendly land use, and parking brokerage services to help businesses share and trade their parking resources;

- include both positive and negative incentives. TDM programs tend to be most effective when they improve consumers' travel choices and provide incentives to use alternatives to driving when possible;

- work to develop and maintain cooperation between transportation agencies, transit service providers, businesses, employees and residents who are affected by their programs;

- produce an annual "State of the Commute" report, which describes TDM programs and resources, travel trends, and comparisons with other communities; and

- utilize increased parking rates and parking revenue to fund TMA initiatives.

To achieve the additional person trips managed into the downtown City Dock, recommended system and demand management strategies may include:

Parking Management Plan. Developing a parking management plan to include some or all of the following elements:

- Additional shared parking arrangements
- Increased shuttle service
- Car shares (e.g. Zipcar),
- Carpool priority parking and ride share coordination,
- Performance parking,
- Bicycle amenities (e.g., lockers, parking and rentals),

Educational Materials. Develop and disseminate educational materials about new or improved travel choices and economic benefits of alternative travel options through websites and social media.

Mode Share. Monitor mode share through frequent counts of vehicles, pedestrians, bicycles, transit, parking surveys and employee surveys and producing an annual report.

The City should consider:

- studying, managing and developing strategies to improve and fund transit (capital and operating costs), pedestrian and bicycle facilities, and modal connections;

- marketing and publicizing travel choices through flyers, kiosks, websites and social media for commuters, shoppers, and visitors;

- identifying appropriate parking strategies and programs, and improving wayfinding signage

7.7 Spot Intersection Improvements

The following summarizes minor spot intersection improvements noted through the course of the field inventory and documentation, related to traffic controls such as signing, signals and pavement markings.

Calvert Street at Bladen Street

- Push buttons for pedestrian signals are not easily accessible and should be located on a pedestal pole
- The missing "Keep Right" (R4-7) sign facing eastbound traffic should be replaced
- Vehicles were observed to run the red light on the left turn from Calvert Street. It is recommended signal timing and yellow and all-red clearance intervals be reviewed for adjusting the split to provide more time for this movement or coordination to adjust the offset to meter the approaching vehicle platoons.

College Avenue at Prince George Street

- The crosswalk sign facing southbound traffic should be relocated in front of telephone pole.
- Construction of bump-outs could be provided extending the sidewalk adjacent to St. Johns College to reduce the pedestrian crossing distance across College Avenue

College Avenue at King George Street

- If right-of-way is available, consider widening the sidewalk behind the existing utility pole on the northwest corner to provide adequate clearance

Church Circle at Duke of Gloucester Street

- Consider installing countdown pedestrian signals

Church Circle at Northwest Street

- Consider installing countdown pedestrian signals

State Circle at Maryland Avenue

- Sight distance of pedestrians in crosswalks is partially obstructed by parked cars. Consider restricting parking 25 to 50' near crosswalk and/ or installing pedestrian warning signs

Main Street at Conduit Street

- There is an extra signal head facing the wrong way down Main Street. This signal head should be removed to eliminate any confusion

Duke of Gloucester Street at Conduit Street

- Consider a No Right Turn On Red condition from Duke of Gloucester as sight distance is restricted down Conduit Street
- There is no pedestrian signal on the northeast corner of the intersection. It is recommended to install a pedestrian signal there as all other sides of marked crosswalks have one already

Duke of Gloucester Street at St. Mary's School

- Consider a No Right Turn On Red condition exiting the St. Mary's School driveway so cars do not block the sidewalk from school children and to address restricted sight distance due to the brick wall to the west as well as the on -street parking

8.0 NEXT STEPS

It is intended that the recommendations presented herein will provided a more detailed blueprint for the City and stakeholders to develop a program to achieve a more balanced transportation system for the downtown City Dock area. This can be realized by implementing a 'pedestrian first' and pedestrian priority mentality in all roadway and land use design elements.

To support these recommendations, ***accommodations for the prioritized mode must in some cases precede consideration over improvements, operations or capacity for other modes in the corridor*** (e.g. bicycle lane replacing a second travel lane or signal timing for pedestrians disrupting vehicular traffic progression).

Moving forward, the following issues are listed for further study and detailed design to refine the alternatives, solicit stakeholder input, secure funding and implement construction:

- Perform detailed traffic analysis including intersection level of service, delays, volume-to-capacity ratios and queues using Highway Capacity Manual methodologies and advanced computer modeling and simulation (e.g. Synchro). Level of service should also be performed for pedestrians, bicycles and transit.

- Perform an assessment of the traffic signal system technology (hardware, software, maintenance) and operations (timing programs, cycle lengths, vehicle and pedestrian clearance policy).

- Perform a wayfinding systems analysis.

- Develop detailed design of preferred improvements including truck compatibility, landscaping streetscaping elements.

- Construction cost estimates.

- Public and Stakeholder review/ coordination with other projects.

- Research and develop a financing strategy including City funds, County, State and Federal funds, and competitive grants such as Transportation Enhancement Program (TEP), Congestion Mitigation and Air Quality (CMAQ), TIGER, Safe Routes to School, etc.

- Develop Construction Sequencing for potential multiple concurrent projects.

- Establish a data collection program for benchmarking and monitoring of traffic patterns and mode share.